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Virgil M. Faires is Professor, Department of Mechanical Engineering, North Carolina State College

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JESSE S. DOOLITTLE *is Professor of Mechanical Engineering at North Carolina State College.* ALEXANDER H. ZERBAN *is Professor of Mechanical Engineering at Pennsylvania State University.*

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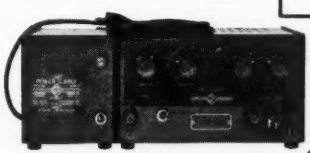

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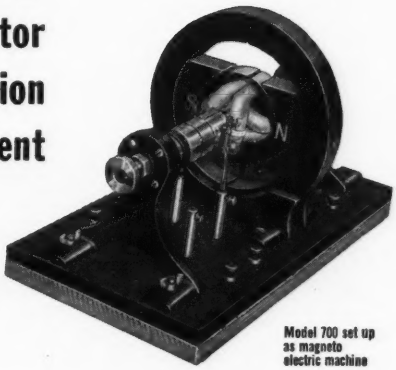

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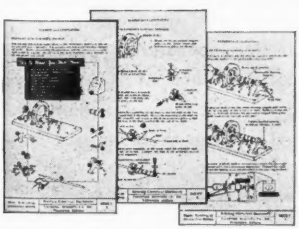

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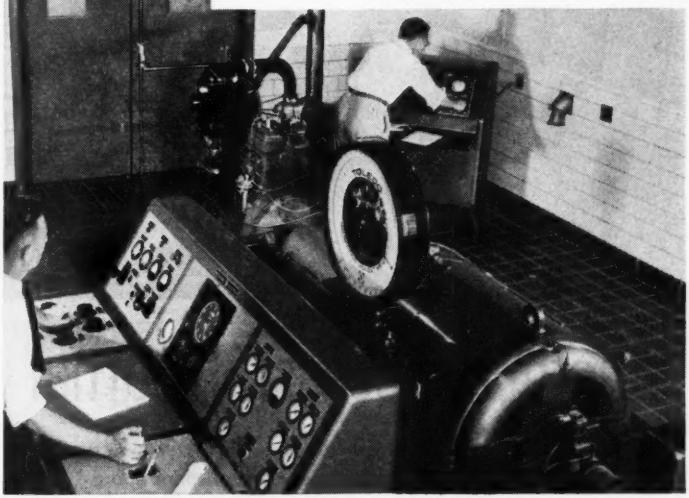

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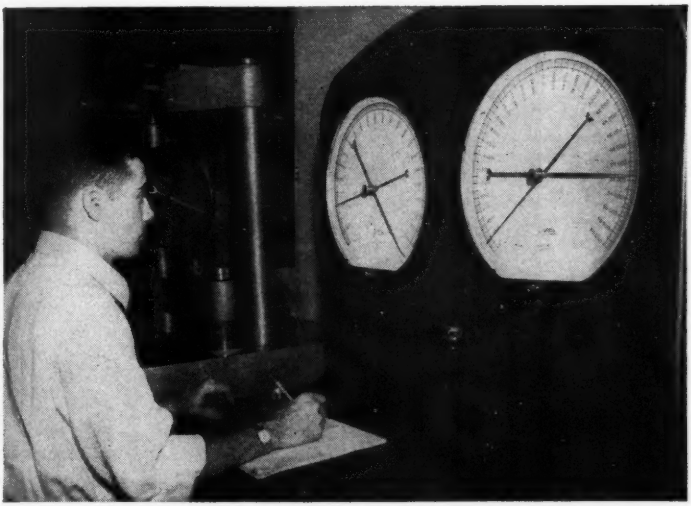

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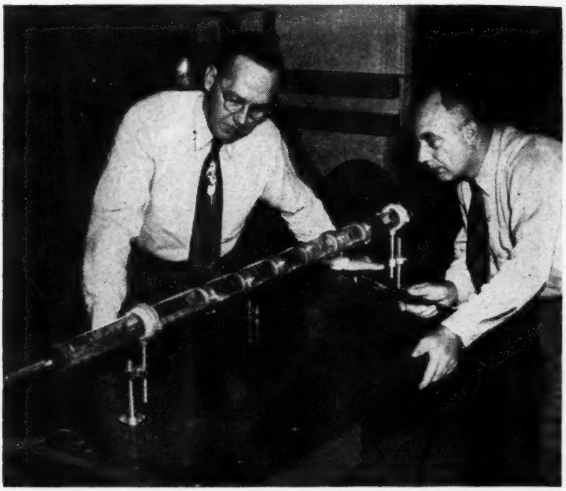

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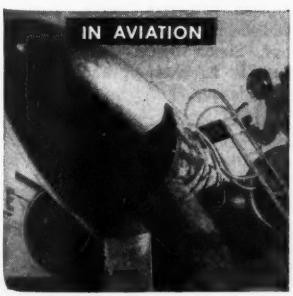

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CONTRIBUTING AUTHORS

Royal Weller, H. P. Robertson, Leonard I. Schiff, Frederick Seitz, Charles Kittel, W. D. Hershberger, William A. Fowler, R. V. Langmuir, Glenn T. Seaborg, W. K. H. Panofsky, Jesse Greenstein, David T. Griggs, Roger Revelle, Leonard B. Loeb, Walker Bleakney, Simon Ramo, John Bardeen, J. B. Wiesner, and Louis N. Ridenour.

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▶ Dr. George Gullette and his Field Study Group have taken a vigorous hold of the Humanistic-Social Research Project and are visiting colleges and universities in search of outstanding achievements in this area of education. They are seeking evidence of effective organization of subject matter, teaching methods, programs which stimulate interest in these subjects and general excellence of curricular objectives. This material will be reviewed by the Humanistic-Social Research Committee headed by Dr. Edwin Burdell, President of Cooper Union. The Committee will project ahead with their own views and recommendations. A preliminary report of this project is anticipated in June 1955. The project will probably require two years to complete. We will keep you posted on its progress.

▶ The two Summer Institutes for 1954 proved to be highly successful, judging from the enthusiastic comments of those who attended. The Summer Institute on Solid State Physics in Engineering Education at Carnegie Institute in June included a number of eminent authorities. Approximately 110 persons were registered in this Conference, which lasted about a week. The Summer Institute on Nuclear Science in Engineering Education held at Northwestern University September 7–10 also featured a number of eminent authorities, including Dr. J. C. Slater, Dr. Samuel Glasstone, Dr. Linus Pauling and others who have worked on the broad front of nuclear science.

The heartening feature of both of these Summer Institutes is that the physicists clearly recognized the problem and offered recommendations for solutions which seemed to be both feasible and adequate. In both Summer Institutes, there was strong recommendation that a course in modern physics be included in all engineering curricula. The subject matter of such a course was discussed at considerable length. Several textbooks will soon emerge which treat this subject in a manner suitable for engineering students. In the Solid State Physics Conference, the fundamental scientific concepts necessary to a reasonable comprehension of the electrical, mechanical, magnetic and metallurgical properties of materials was presented.

In nuclear science, considerable attention was devoted to developing logical patterns of presenting material and also to determine how the fundamental concepts might be developed in courses and curricular options. In both the solid state and nuclear fields it seems desirable to establish elective courses for those students who are interested in these fields. While there was some support for an undergraduate curricular option in nuclear engineering, the prevailing opinion seemed to favor developing graduate programs to satisfy this need.

Summaries of both Conferences will be published in forthcoming issues of the JOURNAL. The complete Proceedings of both Summer Institutes will be available and will be announced in the JOURNAL. The ASEE owes a deep debt of gratitude to the National Science Foundation for its financial support, to the University of Illinois and Columbia University which sponsored the original planning conferences of leading authorities in this field and to Carnegie Institute and Northwestern University for their part in the program.

▶ At long last the Teaching Aids Manual appears about to emerge. Several thousand teaching aids have been reviewed

by the committees and evaluated for instructional purposes. The Bulletin will give fairly specific information not only on the details of the teaching aids and where they can be obtained, but also the instructional purpose and level at which they might be used. An announcement in the next issue of the JOURNAL will give details of its availability. Watch for it.

► The Graduate Studies Division of the ASEE has proposed that a complete investigation be made of the curricular goals and objectives of graduate study. This proposal was favorably received by the General Council and an ad hoc committee has been appointed to draw up a specific program. The membership of this ad hoc committee includes persons who have been active in the Graduate Studies Division and the Committee on Evaluation of Engineering Education.

► The Committee on Evaluation of Engineering Education plans to meet at the time of the Land Grant College Association Meeting in November to discuss revisions in the Interim Report. There seems to be need for a substantial strengthening of the portions of the report dealing with the humanistic-social portion of the curriculum as well as that dealing with graduate study. A Final Report will be prepared and presented at the Annual Meeting in June.

► Some concern has been expressed over the need for coordinating the individual projects which the Society is currently undertaking. These include the projects on Evaluation of Engineering Education, the Graduate Studies and the Humanistic-Social Research Program. The Executive Board has expressed the view that these should proceed as independent projects with overlapping membership on the various committees and that if coordination is necessary, a coordinating committee can be appointed at some future time to resolve any conflicts in the viewpoints. Ultimately, all of these reports might be published in a single volume.

► The ECRC will again publish its Directory and Review of Current Research this year. It is also planning to publish a book on Creativity in Research, this being a compilation of many interesting papers presented at various ECRC meetings on the subject.

► The ASEE was represented at the EUSEC Conference on Engineering and Education in Switzerland by our Past President, Dean L. E. Grinter. Other U. S. delegates included Dean Thorndike Saville and Colonel L. F. Grant. Considerable interest was expressed in the ASEE Interim Report of the Committee on Evaluation of Engineering Education at this conference. The U. S. delegation was sponsored by ECPD.

► The ASEE was represented at UPADI, the Pan American Conference on Engineering and Education, by Dean W. A. Lewis and Dr. Ralph Morgen.

► May we call your attention to the fact that copies of the Interim Report of the Committee on Evaluation of Engineering Education are available at ASEE Headquarters. The price is 20 cents per copy or 12 cents per copy in lots of 100 or more. Over 8,000 copies have been sold thus far.

► To all those who made the Annual Meeting last year such an outstanding success, we owe our deep appreciation. Dean Everitt and Professor Lisle Rose at the University of Illinois, together with their efficient local committees, helped to make this one of the most memorable events in the history of ASEE. The list of persons who contributed to programing the outstanding conferences of the Councils, Divisions and Committees would be too long to name here. However, those who attended have eagerly testified to the outstanding achievement of this Annual Meeting.

(*Continued on page 199*)

The ECPD Accreditation Program*

By H. L. Hazen

Chairman, Region II Education Committee, Engineers' Council for Professional Development

A sudden upsurge in awareness of accreditation and of questions about its nature and modes of operation has recently occurred, following the circulation of a preliminary draft report by the ASEE Committee on Evaluation of Engineering Education a few months ago that included some material on accreditation of undergraduate engineering curricula. This accreditation activity does affect in a substantial way the well-being of many engineering schools; hence the increased awareness and interest are indeed fortunate. However, detailed information concerning the entire accreditation activity has not been readily available in published form.[1] It is the purpose of this paper to describe the operations of the ECPD accreditation process, the nature of its standards, and the character of the problems that are regarded as most significant in its operation.

Beginning in 1932, the Engineers' Council for Professional Development undertook to evolve a program of accreditation for undergraduate engineering curricula which led to the first publication of an accredited list in 1936. This in some ways paralleled the earlier program of the American Institute of Chemical Engineers, now integrally associated with the ECPD program. Heretofore ECPD accreditation has attracted relatively little attention except among those actively associated with it and among institutions that have to a greater or lesser degree fallen short of full approval.

The official statement of principles of ECPD accreditation appears each year in the annual report of the Engineers' Council for Professional Development, which can be obtained for a small fee from the ECPD headquarters at 29 West 39th Street, New York.

In the early thirties the movement toward state registration of engineers was in a vigorous process of development. Each state board of registration needed a list of schools whose engineering curricula were judged to provide adequate educational preparation for prospective registrants. It quickly became apparent to the National Council of State Boards of Engineering Examiners that a national list and not 48 separate state lists was essential to avoid serious complication. The National Council therefore appealed to the founder engineering societies for help in establishing a master list. Any state, of course, could modify such a list for its own use, but a national list would be at least an important starting point. The Engineers' Council for Professional Development persuaded the late Dr. Karl T. Compton, then recently made president of Massachusetts Institute of Technology, to head a committee to establish appropriate accreditation procedures.

*Presented at the Annual Meeting of ASEE, University of Illinois, Urbana, Ill., June 15, 1954.

[1] For a recent brief statement including the historical development, see N. W. Dougherty, "Accreditation of Engineering Curricula," *Jour. Elec. Eng.*, Vol. 44, No. 5, Jan. 1954, pp. 290–93.

This original ECPD Committee on Engineering Schools (changed October 21, 1950 to Education Committee) included a representative from each of the then seven constituent societies of ECPD. There were seven committee members, and the country was divided into seven regions, each member serving as chairman of one regional committee for undergraduate engineering curricula.

The principles of operation formulated by this original committee and approved by ECPD proved sufficiently sound to require relatively little change. These principles as stated are broad rather than specific in character. They purposely omit quantitative standards for determining acceptability. The absence of definite specific standards has been criticized from time to time, but thus far, in the judgment of those who over the years have been most responsibly concerned with the activity, this absence is an important strength in the ECPD accreditation activity.

Present Organization and Operation

With this sketch of historical development of the ECPD accreditation program as a background, we turn to its present organization and operation.

The Engineers' Council for Professional Development is now comprised of official representatives of the eight following professional organizations: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, The Engineering Institute of Canada, American Society for Engineering Education, American Institute of Chemical Engineers, National Council of State Boards of Engineering Examiners. Its activities and actions therefore have the status in the engineering profession provided by these constituent organizations.

The list of accredited undergraduate engineering curricula is published each year in the ECPD Annual Report. This list results from actions taken by ECPD upon the recommendations of its Education Committee.

The Education Committee is charged with the working responsibility for organizing and scheduling inspections of individual institutions, considering the reports of inspection committees, and preparing recommendations for final actions by ECPD. Membership on the Education Committee includes its general chairman, a secretary, a chairman and vice chairman for each of seven regions into which the country is divided, such members at large as the Council may appoint (one at present), and a representative of the Engineering Institute of Canada, a total of 18 persons.

The regional vice chairman are new this year. The Education Committee has repeatedly felt the need of having counsel at its meetings from a member of each institutional visiting committee. By having a vice chairman as well as a chairman for each region, it becomes practicable for one or the other to serve as a working member of each institutional inspection committee.

Briefly the operations are as follows. Early in each academic year the regional chairman and vice chairman review the status of institutions in their territory, prepare a list of those whose existing term of accreditation for one or more curricula terminate during that academic year, and check this list with the office of the Education Committee chairman. Inasmuch as ECPD examines curricula only on invitation by an institution, such an invitation is normally forthcoming, either on the initiative of the institution or upon inquiry by the regional chairman. Upon receipt of such invitation, the regional chairman requests the general chairman to send the appropriate bill and questionnaire forms. Subsequently an inspection committee is selected by the regional chairman from the list of constituent society members approved by the respective societies. The Annual Report of ECPD contains this

list. Inspection committees often include persons from adjacent regions where this offers the advantages of availability, transportation, expense or inter-regional comparisons, or in special cases other persons approved by the appropriate professional society.

While the regional chairman or vice chairman is expected in the normal case to be a member of a visiting team, and may be the chairman of this team, he may select another member as chairman in order to distribute the not inconsiderable work load; and perhaps more important, to avoid undue influence of any one person in the preparation of the final reports and recommendations of the inspection committee.

The inspection committee chairman works closely with the representative of the institution, usually the Dean of Engineering, in planning the actual visit. At a mutually convenient time, influenced by the period required for the preparation of the answers to the questionnaire and the convenience of the institution and inspection team members, the team visits the institution. In most cases such a visit requires two days. In recent years the undeniable pressures on almost all who were qualified to serve on inspection teams has tended to result in a shorter inspection time of one day and sometimes a short day. Education Committee experience shows very clearly, however, that the better part of two days is a minimum requirement for adequate on-the-spot data gathering, and this is now required except in special cases. This two days is apart from the preliminary study of catalogue and questionnaire material and the time required for the preparation of the report. Thus each inspector must expect to contribute a minimum of about four days for each institution that he visits as an inspector.

Following as promptly as possible after the actual visit, each inspector prepares his report on the particular engineering curriculum and one or more supporting departments to which he is assigned by the visiting committee chairman, and submits his report to this chairman. The visiting committee chairman then prepares a summary report (in addition to his own individual department report), including the recommendations for action upon which he and his committee have agreed at a final conference at the institution, confirmed or modified by subsequent correspondence. This report goes to the general chairman of the Education Committee.

Confidential Document

As a matter of ECPD policy, this final visiting committee report, including the chairman's summary and the individual inspectors' reports, is a confidential document available only to the members of the Education Committee and the ECPD Council.

The Education Committee meets in June, usually in connection with the annual meeting of ASEE, and again in October just prior to the meeting of ECPD. Prior to the June meeting both the regional chairman and vice chairman will have reviewed thoroughly all of the reports on inspections made in their region during the academic year just ending, and will have prepared a tabular summary for the use of the Education Committeee in its deliberations. At this meeting the results of all institutional visits are considered at length. This, of course, is where the real work of deciding actions is mainly carried out. As an aside, it may be remarked that these are strenuous sessions. The committee takes its responsibilities seriously (as do all participants in this entire program) and any observation or argument that appears to have an element of pro or con bias is promptly challenged. One cannot claim infallibility for the results of such deliberations, but I believe that I have the support of the entire committee—by temperament and by profession independent thinkers—in the claim that truly sincere, earnest effort without stint is applied to

these discussions in the effort to derive sound, objective conclusions.

The second meeting in October is similar and considers cases for which final reports were not available in June. Each of these meetings usually requires the better part of two days, including some time devoted to questions of operation and policy. Recently a third meeting has been called in mid-winter to consider policy matters.

At the annual meeting of ECPD held in September or October the chairman of the Education Committee presents his report to a closed, executive session of the Council. The official Council action is promptly transmitted to each institution concerned, together with a statement in summary form of the principle observations of the inspection committee. The annual report of ECPD, issued following the annual meeting, contains the up-to-date list of accredited curricula.

The receipt by an institution of the official notice and statement is often not the end of the operation. In fact, much constructive work is accomplished subsequently, as discussed later in this paper.

Having thus disposed of the elementary mechanics of the accreditation operation, let us look at some of the aspects of the operation that experience indicates are significant. We may as well tackle one of the more difficult aspects first.

What does ECPD require as evidence of an acceptable standard for accreditation? Basically the answer is the combined judgments of the visiting committee, the Education Committee, and the ECPD Council successively exercised. Many will say, and do say, that ECPD should have a much more definite and explicit measuring stick, that the judgment of a group of men is altogether too vague and illusive a standard by which to appraise a major activity constituting the lifework of tens or hundreds of individuals. The use of definite, quantitative indices with an explicit statement of corresponding, acceptable levels of these indices is urged.

Naturally this subject has been given the most serious and extended consideration, both at the time of the inauguration of the ECPD accreditation program and more or less continuously subsequently. The conclusion uniformly reached by those responsible for this operation is that engineering education, in essence a subtle and complex operation, depends basically for its quality upon the qualities of faculty, administration, and students. One can, and some organizations do, attempt to apply a quantitative and definite measure to the qualities and performance of people individually and collectively in an organization as a measure of quality or merit. In the judgment, however, of those who have looked at this question most searchingly in behalf of ECPD, it has appeared that the combined judgment of several highly respected leaders of the profession can appraise the essential educational experience provided by an institution far better than the most complete and complex type of scoring.

Quantitative Criteria of Acceptability

It may be remarked in this connection that some accrediting agencies—and there are many with whom college and university presidents have to contend—do have quantitative criteria of acceptability. Recently a righteous revolt of college presidents against the cumulative impact of all agencies claiming accreditational jurisdiction has expressed itself in the formation of a National Commission on Accrediting. It is perhaps worthy of note that ECPD is included among those agencies whose over-all activity has been least criticized by NCA, whereas some of the agencies considered the least successful and sound are those having explicitly stated quantitative standards of acceptability.[1]

[1] Considerable information concerning accreditating agencies in the United States and the lists they have prepared is given in Bulletin 1952, No. 3, "Accredited Higher Institutions"—Theresa Birch Wilkins, published by the Office of Education of the Fed-

This is not to say that ECPD does not use quantitative measures and apply quantitative criteria. Can you imagine any group of engineers missing any reasonable, or even unreasonable opportunity to apply numbers to one of their activities? No, you can rest assured that in this ECPD operation the engineers and engineering educators do ask for and talk in terms of numbers, budget, student, faculty, library, salary, teaching load, space, curricular composition and emphasis. All these and many more matters are examined in quantitative terms. But it becomes abundantly clear to anyone concerned with this evaluation operation that there are less concrete and tangible elements involved that have an importance and significance far beyond those capable of quantitative measurement, although they vary in a manner that is often unique and peculiar to a given institution. Hence, to let supposedly objective, quantitative standards weigh heavily in one's judgment at the expense of adequate emphasis on these more elusive qualities would be to miss some of the really important criteria for accreditation.

We who have had some experience in the operation realize all too well that human judgment is fallible; that inspections are less than complete and exhaustive; and that different individuals necessarily make somewhat different judgments on a given question. On the other hand, it is seldom that a group of inspectors drawn from different professional fields, different organizations (including both education and industry) and of widely varied experiences, will differ significantly in their appraisal of a given institution. Very seldom is there important disagreement among the members of a visiting committee as to the nature and quality of the operation observed. The primary question in cases that are obviously marginal is whether the overall educational opportunity, including strengths and weaknesses, good features and bad is adequate to prepare the engineering student to develop into a responsible, competent engineer.

With this brief statement concerning the ultimate nature of ECPD standards, let us take a brief look at the kind of thinking that goes on in the minds of members of the visiting committee, of the Education Committee, and of the Council of ECPD. What is regarded as important; what are some of the typical questions that arise; what are some of the characteristic strengths and weaknesses that occur time and again in institution after institution? If I can convey something of the underlying quality and character of the ECPD operation at the working level, by spot samples, I am sure that any one of you will be able to supply rather accurately the many, many details that are omitted from my description.

When we attempt to appraise a curriculum, or group of curricula, at a given institution, we recognize that the quality of the faculty is the basic, all-important determinant of quality for the school. This is also the most hazardous and difficult quality to appraise. Second only to faculty in importance is the kind of support given to the faculty by the institutional administration. Over the long term, of course, administrative policy as expressed in the selection and support of faculty is what determines the quality of an institution. Those associated with ECPD accreditation realize all too well and have had brought home to them forcefully in concrete cases the hazards of standing in judgment on one's fellows. But this is the important issue, and we may as well recognize the role to which we are inevitably assigned when we undertake such an operation as determining acceptability of an institution for ECPD listing.

In thus stressing the importance of faculty relative to other considerations,

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eral Security Agency, and for sale by the Superintendent of Documents, U. S. Gov't Printing Office, Washington, 25, D. C. Price 35 cents.

I am not wilfully diverting attention from the actual curriculum, from the kind and quality of subjects which are taught to the students or to which they are exposed, the laboratory facilities, the library, the academic standards as evidenced by samples of students' actual work in home problems, examinations, laboratory reports, essays, etc., or any of a number of other components that go to make up the educational opportunity offered and the quality of response required from the students. All these are of course carefully examined by a visiting committee. But I am recognizing that all of these various opportunities offered by a faculty to the students are simply an expression of the character of the faculty.

What is Meant by Good Faculty

Now comes the all-important question, what do we mean by good faculty. Before answering this we have to ask ourselves the question, what do we wish our students to learn. Do we wish them to be merely competent practitioners of today's technology, or do we wish them to achieve that quality of understanding of science, engineering science and human affairs that can deal confidently with the new problems on which they will have to exercise responsibility five, ten and twenty-five years hence? The answer to this question is all-important in determining the standards by which we appraise faculty. ECPD takes the view that the latter ideal is the one that it seeks to recognize and promote, but that as yet it must regard a well done program of the former sort as meeting minimum standards.

What do we like to see in a faculty member? First and foremost, he must deeply enjoy seeing and helping young people to grow and develop. We like to see in him a substantial element of genuine scholarliness, the insatiable curiosity to learn, to acquire deep and fundamental understanding. We want to see him convey this sense of scholarly curiosity and insistence upon deep understanding to his students. We like very much to see in a faculty member evidences of individual and independent thinking. This may express itself in a research program, in engineering practice of a responsible and non-routine character, or in consulting work that is professionally challenging. Some participation in a graduate program where the creative spirit is alive contributes strongly to intellectual vigor. The mere keeping actively abreast of some phase of his field and continually working the ideas underlying new developments into his undergraduate teaching program is some evidence of vitality and continued growth in a faculty member. Stated negatively, repetitious teaching of a textbook, even though competently done in itself, seldom presents to the student the challenge of ideas not yet understood or of problems not yet solved. The professor who himself is at grips with some unsolved problem as a part of his professional activity, can and does usually bring to his students a spirit of inquiry, a stimulation to tackle new ideas, and urge to question deeper into partially understood phenomena.

In these days of increasing sophistication of engineering, uneasy deans and department heads often ask whether a doctoral degree is a firm requirement for the acceptability of a new faculty member. The answer is a "No, but. . . ." The requirements for the Doctor's degree overlap to some extent the requirements for a good faculty member. The letters Ph.D. after a goodly fraction of the faculty names in the catalogue are an excellent show piece for a college dean or president. They are, however, no intrinsic guarantee of quality. Educational opportunities and incentives of the present day are such that many, indeed most young people who are qualified to become important faculty members ten or twenty years hence are likely to be working toward the Doctorate or to have it. If a young man on the faculty or instructing staff does not have, or is not working for a Doctorate, we ask: "Why

not, and does this indicate a deficiency in some important qualities for a future faculty member?" A committee can be persuaded with good evidence that a man without a Doctorate is an excellent man. It would be negligent if it accepted the Doctorate alone as a sufficient demonstration of quality as a teacher and a scholar.

An important collective quality in a faculty is the evidence of good team work, of congenial and easy working relations among them, of a sense of common purpose and good communications with the administration. Just as children often bear serious scars from a broken home, so students feel unhealthy effects from a faculty torn by schisms and petty strife. Although we seldom see such conflicts in an engineering faculty, high collective morale cannot be taken for granted. On the other hand, even the best of teamwork cannot replace notable individual performance and non-routine individual productivity. Good teamwork can accompany congenial mediocrity which concerns itself with achieving smoothly-operating routine and is completely lacking in stimulating ideas.

One of the most difficult problems faced by a visiting committee, and subsequently the Education Committee, is how to appraise the school whose faculty are routinely competent, who are doing an exceedingly conscientious and devoted job, often under serious financial handicaps, whose students are obtaining thorough drill in elementary engineering science and its applications, but who show little evidence of professional thinking or activity beyond the confines of routinely taught undergraduate subjects. They obviously rate an A on devotion, thoroughness, and subject matter adequacy within a restricted domain, but rate D or E or Absent on nearly all elements expressing the forward march of the profession and field. Do they pass or don't they? This is a tough question. For many students and many jobs using engineering graduates such a training is apparently adequate. In its draft-report suggestion of a "professional-general" curriculum the ASEE Committee on Evaluation was attempting to devise an appropriate scheme for recognizing good programs of this sort, but also recognizing that they are quite distinct in kind and objectives from those of more scientific and research-oriented character. The fairly routine curriculum might well meet minimum acceptable though obviously not high standards for professional-general objectives, even though it neither is nor is intended to be research-oriented.

Please don't misunderstand me. This doesn't mean that the professional-general curriculum may not yield future corporation presidents or general managers or indeed research directors.

In looking at a faculty the visiting committee takes quite seriously the institution's salary scale, bearing in mind local living costs and requirements. Here is often a problem of the first order. Many institutions, especially some of the worthy small private colleges have not, despite great efforts on the part of their presidents, been able to build up their assets nearly as fast as the inflation of the last decade and a half has torn them down. The fact that such institutions retain any faculty, much less a faculty as loyal and surely dedicated as they have, is indeed a tribute to the reality of human ideals. But able, new young people of the quality to compete freely in today's market, though willing to make substantial sacrifices for teaching as compared with industry, cannot in fairness to themselves and their families accept the degree of sacrifice imposed by the salary levels in too many of the small colleges we cherish. This is a truly tragic situation.

The present quality of faculty and the outlook for the future raise serious questions for a visiting committee. With the profession calling through ECPD for a raising of minimum standards of acceptability of engineering curricula, what is the right answer in such a case? This

is the kind of question that tries the souls of the Education Committee.

Administrative Organization

Turning now to some of the other matters at which a visiting committee looks, it asks questions about the formal and the actual administrative organization. While it expects no single pattern and regards men as clearly more important than formal organization, it does expect evidence of sound educational leadership, and of an administrative mechanism that permits this leadership to be effective in cooperation with its faculty. Educational institutions often appear to lack such crucial tests as dividend performance or stockholders meetings to force them to face up to uncomfortable issues, with the result that administrative anomalies, wrong in theory and bad in practice are sometimes tolerated, to the obvious detriment of the quality of the operation. ECPD has no fixed standards of acceptability other than that the administration should be reasonably effective in practice.

On another subject, housing and facilities, the ideas are rather simple. Everyone enjoys seeing fine housing and excellent laboratory facilities. However, the quality of the facilities and the quality of work that is done in them do not necessarily have a very high correlation. The applicability of this statement is not limited to educational institutions. A visiting committee is likely to object strenuously, for example, to a Mechanical Engineering Department whose students have no access to any working laboratory in Heat or Materials. A few engines, pumps, and an old turbine that show no evidence of adaptation for even elementary meaningful measurements leave a committee unpersuaded. If, on the other hand, with mediocre equipment one or two professors have developed ingenious means whereby students can learn important principles in laboratory experiments, the committee is likely to commend the Mechanical Engineering Department but to call the administration to task for inadequate support of faculty and students.

Then, of course, there is the case, not too common, of fine equipment in a new building, shiny and unspotted, with no evidence that anyone has ever drilled a new hole or changed a single screw in order to permit a new or better measurement or to alter a characteristic. The presumption will bear investigation that the students get little understanding of what goes on inside the prettily painted housings, and that the faculty are not much better off. This kind of display is also less than impressive.

In a positive sense, a committee is happy to see a laboratory in which it is obvious that faculty and students work hard to gain an understanding of the underlying principles of operation, and the deviations from simple theory that practical design and other limitations impose. If the equipment is of the "boughten-ready-made" variety, the sales representative might shudder to see the state of the finish and the number of less-than-aesthetic appendages that his equipment has acquired. Next to it is a monstrosity similarly bedecked that the professor persuaded the company for which he does consulting to place in the laboratory on indefinite loan at the end of an experimental job. Both of these pieces of equipment and others like them throughout the laboratory suggest intellectual ferment and search for understanding on the part of both students and faculty. Student laboratory project reports and theses deriving from this laboratory as well as the professor's account of the new ideas his students are exploring confirm these suggestions as fact. Here a visiting committee can become enthusiastic.

On still another subject, the committee looks at the curriculum, its level and content. Is it reasonably proportioned as between sciences, engineering sciences, applications, and general education? Are the entering students sufficiently well prepared so that the sciences and the engineering sciences can be and are based

upon a reasonable grasp of the calculus, or better still, elementary differential equations? Is the Physics taught with or without the calculus? Does the Mechanics make any serious entry into Dynamics, or is it limited largely to Statics plus the most elementary Dynamics? Does the Electrical Engineering for non-electricals recognize the implications of the vacuum tube, not to say the transistor, and the dominant part it plays in measurements techniques in recent years in all scientific fields? Does the strength of materials or applied elasticity recognize seriously the phenomena of plastic flow or of fatigue? Has the structures sequence taken into account the implications of the Tacoma Bridge failure?

Broad Horizon and Scientific Depth

Has the engineering faculty recognized that the engineer serves society not by technical engineering alone but as a citizen, as a cultured member of the community and that therefore his education calls for at least a reasonable minimum exposure to the kind of ideas that are found in literature, in history, philosophy, the graphic arts, economics, government, international relations? It not infrequently happens that the curriculum in which it is claimed time is simply not available for general education is burdened by a supercargo of engineering practice, emphasis on manual skills and technical specialties which the engineering faculty has not yet had the insight or courage to throw overboard in favor of a broader horizon for their students and greater scientific depth in their own field.

In the details of individual subjects, the visitor likes to see in the samples of student work—home problems, examinations, laboratory reports, project papers, etc.,—evidences of the student being forced occasionally to leave the beaten track and develop some of his own ideas. Standard exercises in class and laboratory have their place as a means of drill on elementary principles, but the problem that departs from the beaten track, that reflects a pertinent but unusual application of a principle encountered in the course of a professor's consulting work or research; the problem in laboratory or seminar course that requires a student to explore and develop an understanding in an unfamiliar field; these are all indicators of cerebration in the professors and probably in the students. These are healthy signs of good educational experience. Also there is no substitute for high standards of student performance.

The inspection committee is always concerned about the presence in the curriculum of any appreciable number of professional subjects or courses that are primarily descriptive and qualitative rather than analytical and quantitative in their essential character. The competent professor rather regularly works in, quite incidentally, many of the qualitative and descriptive aspects of a field while tackling the more fundamental and difficult, scientific and quantitative aspects. It is, of course, the understanding of the inner principles of operation and fundamental theory that distinguishes the professional engineer from the technician, who is expected to be more skillful than the engineer in the practical techniques of daily operation of involved technical equipment.

There are some other aspects of the general picture that inspection committees and the Education Committee encounter in their consideration of curricula offered for inspection, concerning which comment is appropriate. An institution head, in response to criticism of apparent weaknesses in program or faculty, often replies that their students receive many offers of employment, that they seem to do well in practice, and that therefore their education at the institution must have been less deficient than ECPD has indicated.

The facts of student performance after college in general have to be taken into account. As one who has had considerable association with graduate school activity, I must admit that in professional promise at the graduate school level the outstanding man from a little-known

school, given time to repair gaps in preparation and opportunity, is likely to far outstrip a reasonably good man from a reputedly strong institution. The latter will have, of course, more immediate facility in elementary technical operations. The outstanding man from the relatively weak school may have to shore up considerably his undergraduate foundation before he tackles full scale graduate work, but he will subsequently outrank his intrinsicly less able associate with better preparation. In other words, it is pretty hard for a poor school to spoil a good man. Conversely, the best school cannot make a good product out of poor material; it can merely encourage, inspire, and develop good material. All experienced industrial employers as well as graduate schools are thoroughly aware of these facts.

Appraisal of an engineering school is therefore denied any easy yardstick for measuring the school through determining the performance of its graduates. Twenty-five years from graduation a survey of graduates' accomplishments may show a significant pattern but this has little relevance to the current status. We are therefore left to depend largely on a basically subjective standard of judgment of men recognized as competent in their profession as to what constitutes an acceptable minimum of educational experience in preparation for engineering.

Problems Implicit in the Accreditation Process

Another observation I believe is very important in looking at this accreditation picture broadly. A difficult and trying experience occurs, of course, as a sequel of failure to accredit or of a less-than-maximum-term accreditation, and of the receipt by the president of the accompanying statement of particulars as to strength and weaknesses. Not one of us will take such a reflection on the quality of his institution lying down. The most natural human instinct is to rise immediately in self-defense. One immediately searches, often successfully, for imperfections in the findings of an inspection committee that cannot take time to do a truly exhaustive study. Unhappiness at a less-than-favorable report is not reduced by the normally justified conviction that the institution and its faculty are conscientiously and earnestly putting forth their very best efforts, often under serious financial limitations. Their spirit, enterprise and wholehearted devotion to their endeavors has almost universally resulted in a loyal and devoted group of alumni, staunch supporters among the local industries, and a civic pride in the operations of the institution that are hard to square with a less than flattering ECPD action. Yet as measured against the standard that men respected in the profession consider necessary to prepare engineers adequately to face important future problems, this institution and its work are simply falling short. Every one of us who has had occasion to tell a subordinate or employee of his shortcomings is quite cognizant of the problems of communication under these circumstances. There are equally difficult communication problems when ECPD reports unfavorably to an institutional president. Psychologically he cannot be expected to have an immediate full understanding of this report, despite the best will in the world. The natural reaction is that an injustice has been done, and for this no one can blame him. Here then is another not-so-trivial problem implicit in the accreditation process.

Following these initial defensive reactions, however, there is likely to be a very constructive phase in which an institution decides to take a very serious look at itself, often with the help of other educators and industrialists interested in education. Not infrequently it happens that Education Committee or Regional Committee members are asked for their specific suggestions and advice. While some general suggestions may be appropriate, the necessary response here is that the role of counsel and jury must in the nature of things be kept separate and independent, else too small a group exerts

too wide an influence. It has to be emphasized, and this is a point that is not too readily understood by many, especially those who are in umbrage on accreditation, that there is no one set of conditions to be satisfied in order to achieve accreditation, that there are many ways and patterns in which an entirely acceptable, and indeed commendable, program may be achieved. It is at this point that the advocates of definite, quantitative criteria appear most prominently. The questions are asked; in what specific ways are we deficient, what are the standards that we must meet in order to become accredited? If you don't tell us what these minimum standards are specifically, how can you expect us to meet them? It sometimes takes a bit of exposition and education to convey the ideas that are regarded by ECPD as important measures of quality. The key to such a situation is usually the appointment of some new person in a key post, a person who by temperament, interest and aptitude understands and is convinced of the importance, indeed the essentiality of some of the qualities that we have discussed in this paper. Once this type of leadership is present, and it is given support by the president and trustees, matters begin to improve, often very rapidly.

Conclusion

In spite of its serious and seemingly almost insoluble problems, this work is exceedingly stimulating and interesting. It is carried on without fee or honorarium to anyone, actual expenses only of participants being reimbursed by ECPD. Within the constraints imposed by other commitments, services on inspection committees are given generously by the individuals, their educational institutions, and their industrial employers. Rarely indeed does one sense that the degree of responsibility felt under this voluntary arrangement is one whit less than it would be under a generous consulting contract for services.

Suggestions for improvement are welcomed, for those most deeply involved are well aware that ECPD accreditation like any other human institution falls substantially short of perfection. Yet it must be apparent on second thought that the obvious suggestions, and most of those less obvious, are normally hardy perennials. Significant steps forward are likely to come from those who have been actively involved in one way or another, and who are therefore familiar with the actual problems of operation. As in all human institutions, the greatest opportunity for improvement lies in the increase in understanding, ability, and wisdom of those doing the work.

What is the value of accreditation and what is its future? It has supplied the engineering profession with a list of curricula meeting certain standards. This list has been used by State Boards of Registration and other agencies. Apparently being on this list carries significant prestige value, especially for lesser known schools, judging by the efforts they make to qualify. Many cases could be cited in which ECPD action has resulted in substantially raised standards. For the better known schools evaluation for accreditation offers objective appraisal from without and a report that may challenge complacency.

As to the future of accrediting, there continues active but deliberate thinking, especially associated with NCA, that will undoubtedly lead to further evolution. The underlying needs and purposes of the ECPD program, and the over-all quality of its operation, are quite generally recognized. Further evolution in this program may therefore be expected in the direction of developing cooperation with other agencies and associations of colleges and universities consistent with continued effectiveness of ECPD accrediting in meeting its own necessary objectives.

Another article on this subject, entitled "Relations with Regional Accrediting Associations," will be published in the November, 1954 issue of THE JOURNAL OF ENGINEERING EDUCATION.

Editor

Creativity in Radio

Contributions of Major Edwin H. Armstrong*

By JOHN R. RAGAZZINI

Professor of Electrical Engineering, Columbia University

I

My purpose here today is to outline the contributions and to analyze some of the factors which have contributed to the creative genius of one of the great inventors of our time, Edwin Howard Armstrong. He would have been here today to speak for himself were it not for his tragic death some months ago. In discussing Major Armstrong, I may betray a certain amount of hero worship to which I freely confess for he was an heroic figure to all who knew him. In some ways, my speaking for him may give you a better picture than he would have been able to do for himself. Possessed of an innate modesty he probably would have minimized his role and personal contributions to the phenomenal series of inventions which have laid the foundations of modern radio communications. In referring to him I shall use the appellation of Major because he preferred it over others to which he was entitled.

To emphasize the importance of the contributions of Major Armstrong, I shall outline his inventions before going into his life, his times, his education and those personal characteristics which contributed to these successes. The four basic discoveries which represent his most important but by no means only creative contributions are the regenerative circuit, the superregenerative circuit, the superheterodyne receiver, and the broad-band frequency modulation system. These will be taken up in turn.

At the time of the invention of the three-element vacuum tube named the "audion" by Lee De Forest in 1906, radio communication, as we know it today, was launched. In those early days tubes were expensive and scarce and their characteristics none too favorable, so that it was imperative to increase the effectiveness of each individual tube. Setting the then accepted theories aside and embarking on an experimental approach, Major Armstrong was able in 1912 to obtain unheard of sensitivities from a single triode. While commonplace today, the concept of reinforcing a week input signal to the tube by feeding back a small portion of the output signal was revolutionary. He not only observed this phenomenon but was perceptive enough to realize its importance as an invention which he disclosed on January 31, 1913, and finally patented in 1914. The regenerative feedback circuit made possible communications across and between continents with a minimum of tubes.

Shortly after the initial disclosure of the regenerative principle for use as a sensitive receiving detector, Major Armstrong discovered that by increasing the amount of feedback it was possible to cause self-oscillations in the circuit. The tremendous importance of this property was quickly evaluated by Armstrong because a technique for producing oscillation by this means would replace the older spark or arc transmitters then in use. He filed a separate patent applica-

* Presented at the Annual Meeting of ASEE, University of Illinois, June 16, 1954.

tion for this circuit, a factor which later cost him heavily in patent litigation. De Forest was able to win an interference suit in 1924 which resulted in the issuance of patents to himself for the oscillating audion and regenerative circuit and the rejection of Armstrong's application for a patent on the oscillator circuit. Ultimately, as late as 1934 and after long and expensive litigation, the Supreme Court upheld the contention that De Forest was the inventor of the regenerative circuit and oscillator although the engineering and scientific societies, including the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Franklin Institute, generally discredited this decision by awarding medals and honors to Armstrong for his inventions including the regenerative circuit.

These brief references to Armstrong's patent litigation are cited not so much for their importance to the purpose at hand but to emphasize early in this talk a facet of his character which led him to fight tenaciously for what he considered to be right. This he did even when it cost him heavily and when he might have benefited financially by accepting an adverse decision. His lifetime will show many other instances of this characteristic.

Superheterodyne Reception

Chronologically, the second of his great discoveries was the system of superheterodyne reception. The first in the sequence of events leading to this invention was, the heterodyne principle which he studied experimentally and presented in his outstanding paper before the Institute of Radio Engineers in 1916. This paper laid the foundations for the future by rationally explaining the phenomenon of beating two high frequency inaudible signals to obtain an audible difference frequency signal. During World War I, the principle of superheterodyne reception was synthesized as a result of speculation on his part that attacking German bombers could be fired upon more accurately if they could be located by picking up the radiation from their ignition systems. The frequency content of this radiation was very high for those days and could not be picked up by then existing methods. The whole concept suddenly occurred to Armstrong that if he could reduce the frequency of the short waves to a value more manageable for amplification, receivers of much higher sensitivity could be designed. In retrospect, this seems to be a natural outgrowth of his early studies in the field of heterodyne detection. In his 1916 paper, Armstrong was dealing with the reduction of the frequency of a received signal from a high inaudible frequency, say 100 kilocycles to an audible frequency of, say 1 kilocycle, by beating with a local signal at 99 kilocycles. The principle was extended to take a very high radio frequency, say 10 megacycles and beat it down to an intermediate but inaudible frequency of say 150 kilocycles, amplifying at this frequency and then detecting the audible signal in this amplified signal. This invention was not used for its original purpose in World War I but it did become the basis for practically all radio reception including radar. It is interesting to note that the circle was completed only in World War II when radar detection of enemy aircraft came into its own using, a reception technique invented by Armstrong for the same purpose more than twenty years earlier. It can truly be said that the invention of the superheterodyne receiver represents a superb exhibition of inventive genius where one step logically led to another and a set of unrelated facts were synthesized into a useful device.

Shortly after his return from World War I, Major Armstrong became involved in the first of a series of court suits in defence of his patents. It was while carrying out an experiment at Columbia University to prove convincingly that statements made by opposing counsel were in denial of fundamental truths that he came upon the principle

of superregeneration. While testing a regenerative circuit using a miniature transmitter located across the room without an antenna, he noted strange signals coming in with unbelievable signal strengths. Numerous transmitting stations were identified and their signal strengths were far beyond those observed in previous regenerative receiver tests. Far from ignoring this effect, he tenaciously studied it and finally brought to light a new principle of regeneration. What had happened was that the regenerative detector was being triggered on and off oscillation at an inaudible rate so that on the average, the circuit was being operated at a condition of tremendous gain located near the point of incipient oscillation. It was his ability to recognize that he had found a basic and important new principle that accentuated his genius, for it must have been true that many other experimenters had noted the effect previously. As a matter of fact, Armstrong himself came upon some old notes indicating that he had produced superregeneration in his early experiments many years before but failed to recognize it. This is a lesson that he never forgot and one which made him emphasize his persistence and care in experimentation lest unusual phenomena should go by without being noticed.

Frequency Modulation

Major Armstrong's final important invention was that of static-free frequency modulation reception known as FM. Ever since his early days with Pupin at Columbia, he had dreamed of the day when static, that is natural and man-made electromagnetic disturbances, would be overcome and useful signals could be received clearly and with high fidelity at all times. The basic technique used by Armstrong to solve this problem was to employ a system of modulation in which the intelligence was applied to a carrier signal by varying its frequency. This idea was by no means new, having been considered by numerous authorities in the field and having been discarded as impractical and as having no particular advantage over the current amplitude modulation system (AM).

In particular, expert opinion of the day was that the comparison between FM and AM based on both theory and experiment indicated no particular advantages for FM. This situation would have been enough to discourage any investigator from going much further. However, Major Armstrong had other ideas. He studied some of his concepts developed as far back as 1915 which led him to believe that broad-band, not narrow-band FM was the key to the problem. In view of the fact that the energy of the random noise or disturbances admitted into a circuit is proportional to its bandwidth, his notions seemed completely contrary to accepted concepts. The only trouble was that these concepts, correct as they were, were being applied to only one form of FM and did not reckon with the basic element in the Armstrong system which included the amplitude limiter. This device clipped off all amplitude variations superposed on the signal by unwanted static and permitted only the desired frequency variations containing the intelligence to pass through. The broader the frequency swing of the desired signal, the less significant would be the undesired swings due to noise. It was simply a case of the right theory being applied to the wrong model and again Armstrong proved that he was by far a more precise mathematical thinker even though he did not indulge in the writing of mathematical relationships.

In any case, the broad-band FM system including the all-important amplitude limiter was patented in 1933. This invention made possible the reception of almost completely static-free signals even in the midst of violent thunderstorms in the immediate vicinity, and this was indeed a technological triumph. Accompanying this great advantage was that of high fidelity made possible by the broader bandwidth employed by the sys-

tem. Also, it was possible to prevent interference between adjacent stations since the Armstrong system caused the weaker station to be completely suppressed. By employing higher carrier frequencies he opened up a new large piece of the frequency spectrum to broadcasting. Finally, the cost of construction and operation of FM stations was less than that of AM stations with the same coverage.

Conflict of Interests

However, it was one thing to achieve this tremendous success and still another to bring about its acceptance by the broadcasting industry and the government. The conflict of interests between established organizations, like the Radio Corporation of America, and Major Armstrong had begun in all seriousness. The fight to bring about adoption of this, his greatest invention, consumed so much of Major Armstrong's time and energy that he was diverted from his primary activity of study and experimentation. FM proved to be the last of his great inventions and most of his activities from the issuance of the FM patent to the time of his tragic death were directed to the fight for adoption of FM. His devotion to this task proved to be so intense that his FM fight has often been referred to as his Cause. He was cast in the role of the lone inventor pitted against the array of great corporations that characterize our economy. In this task he was as dogged, as brilliant and as assured as he had ever been in ferreting out an interesting and peculiar phenomenon in the laboratory.

This recital of the most important technical achievements of Major Armstrong is by no means complete. It has been given to bring into focus the magnitude of his creativity and life-long achievement and to provide the framework into which to attempt to fit the human being that was Major Armstrong. The remainder of this discussion will be devoted to an attempt to explain the factors which contributed to his amazing record.

II

Edwin H. Armstrong was born in 1890 and spent much of his youth in the city of Yonkers, which as you probably know lies adjacent to New York City. While not wealthy, his family lived comfortably, his father being United States representative of the Oxford University Press. In view of his father's position it is not surprising that he was an avid reader of books, a factor that influenced the course of his life. That his preferred reading dealt with the lives of such great inventors as Volta, Hertz and Marconi was significant. One of his favorite idols was Faraday whose accomplishments he rivalled in later life. During his teens Armstrong filled his attic room in the Armstrong house in Yonkers with all the paraphernalia of the typical radio ham, including various wireless contraptions such as coherers, interrupters and spark coils of the day. Most of his spare time was spent listening to the dots and dashes of other radio hams in Yonkers and vicinity and occasionally picking up Naval and commercial stations both near and far. By the age of 19 Armstrong was ready to enter college and the maturing of the amateur into the professional had begun. It is important to note than even before entering college he had decided with typical singlemindedness to become an inventor in the field of radio and never to the day of his death did he waver from that objective. This man was no confused uncertain young teenager who had to have someone else make up his mind for him!

In 1909 Armstrong entered Columbia University to study electrical engineering and came under the influence of the great inventor and teacher, Michael Pupin, who was then Professor of Electrical Engineering. It was soon evident that, aided by formal training in electrical engineering, he had developed a knowledge of radio which far exceeded that contained

in the textbooks of the day or, for that matter, of many of his instructors. His outstanding performance in this regard led him to study the performance of the then new and revolutionary De Forest audion while still a college junior. His experimentation resulted, as noted before, in the invention of the regenerative detector in the year 1912.

Scientific Turn of Mind

It is important to observe that a major technical contribution made by Armstrong about this time was not just the regenerative circuit itself which was an invention of first rank but also the explanation of the operation of the triode vacuum tube. Until then, it had been regarded as a trigger device, but Armstrong, with typical clarity and logic showed that its performance could be explained by the use of a characteristic curve and laid the groundwork for the vacuum tube circuit theory of today. This illustrates a scientific turn of mind possessed by very few undergraduate students today.

One might be tempted to conclude that Armstrong was a bookworm or possibly a "lab-worm" who paid little or no attention to other aspects of student life. Nothing could be further from the truth. While in college he rode, somewhat recklessly it is said, the hot-rod of his day—a red Indian motorcycle. He entered the usual freshman-sophomore contests and became a tough competitor on the tennis court. The latter sport was one of his favorites and he played well until he sustained an injury to his shoulder in later life. Nevertheless, despite these recreations, Armstrong never wavered from his primary objective, radio. By the time he was a college senior, Armstrong had a basic invention and the benefit of association with Pupin, a foremost inventor in his own right.

Because of his intense interest in his subject and because laboratory facilities would be available to him, Armstrong accepted an assistantship at Columbia University where he continued his work. His salary was quite low, only $50.00 a month, and I have often heard him relate how he used to have his one meal a day at a small restaurant on Broadway near the University because the proprietor was so foolish as to allow him all the bread he could eat with his meal. Not long after his acceptance of this post at the University, his regenerative patent issued and royalties began to pour in at the rate of about $8000 per year.

One might note here that the excellent guidance he received from Pupin and his associates on the management of his affairs as an independent inventor may have laid the seeds of much unhappiness and frustration in later years. Had he renounced all commercial advantage or financial return as his idol Faraday, his creativity might have been even greater because much of the energy he diverted to court actions and litigation would have been available for scientific work. But such was not to be, and much of Major Armstrong's life was spent in the defence of his rights as he saw them. It is interesting to note, however, Armstrong never relinquished his interest in or association with Columbia University and its freedom of thought and investigation, taking over and holding until his death Pupin's chair in electrical engineering. He was always the serious-minded, thorough, experimental scientist.

World War I found Armstrong in uniform as a captain in the Signal Corps. Whoever was responsible for assignment of personnel at that time should be congratulated for having placed Captain Armstrong in a position where he could help solve the problems of communications from ground to aircraft and many other similar problems in which he was a foremost expert. It was in this service that the inspiration for the superheterodyne receiver came to him. Discharged as a Major, he returned to Columbia to resume his life as a scientist and inventor.

Court Clashes

Once back, Armstrong entered into the first of his many court clashes in defence of his patents. The whole question of the regenerative circuit and oscillator against De Forest came up and during the proceedings, Armstrong was made an offer of $335,000 by Westinghouse Company for his regenerative and superheterodyne patent rights. In the meantime, he returned to his work on static elimination with Pupin and accidentally discovered, as described previously, the principle of superregeneration. Concurrently, he participated in the series of tests in 1921 sponsored by the American Radio Relay League which resulted in the successful communication between the United States and England on so called short wave transmissions at a wavelength of about 200 meters. It is significant to note that his colleague, Paul Godley, who picked up the signal in Scotland, used a superheterodyne receiver. Shortly after these tests his superregenerative patent issued, and by 1922 he negotiated with the Radio Corporation of America who wished to buy the rights. Negotiations were completed resulting in the payment to Armstrong of $200,000 in cash and 60,000 shares of RCA stock. This block of stock, combined with 20,000 additional shares for later services, made Armstrong one of the largest stockholders of the growing company. Financially, Armstrong was a multi-millionaire but this made little or no difference to his devotion to radio and his quest for static-free reception.

As a result of many visits to David Sarnoff's office at RCA, he met and courted Sarnoff's secretary, Miss Mac Innes. During this period he lost no opportunity to impress her with feats that were often quite daring and which reflected a bold and boyish personality. The most memorable of these was his hand-over-hand climb of the 400 foot tower of radio station WJZ. When he reached the top he stopped to pose for photographers. Whether or not this had any significant effect on his courtship is hard to say. At any rate, he and Miss Mac Innes were married in 1923.

Shortly after his marriage, Armstrong resumed his series of experiments at Columbia, which culminated in the invention of wide-band FM in 1932 with the patent issuing a year later. It was the fight for adoption of FM which constituted his most bitter series of disappointments. Armstrong tried to interest RCA in his new invention but for reasons which can only be speculative, but which involved the problems of existing investments, the coming of television and possibly personal relationships, he was rebuffed in a manner which offended Armstrong's sense of fair play. At any rate, it may be said that he declared war on RCA to the extent of turning down in 1940 an offer of 1 million dollars for a royalty-free license. The concurrent fight for broadcasting allocations was carried to the Federal Communications Commission where Armstrong finally obtained the allotment of a band in the 40 megacycle range for FM broadcasting. After the war, despite the fact that 500,000 sets were thereby rendered obsolete, the FCC moved the FM band up to its present 100 Megacycle range. This dealt a hard blow to FM, but still it flourished so that by 1949 there were 600 stations on the air. Throughout this latter period, however, RCA was waging war on Armstrong's patent position and most set makers were not paying royalties to Armstrong but were using the so-called ratio detector based on patents held by RCA. Armstrong claimed that this was an infringement and brought suit. The suit was at the stage of pre-trial hearings at the time of his death.

Armstrong fought the battle for FM with the same tenacity he used when attacking his technical problems. Above all, he was outraged at what he considered unfair treatment by RCA, and this may have affected his better judgment so far as personal advantage was concerned. His wife and his colleagues

would have wished him to retire and enjoy his remaining years surrounded by loyal friends and revered as elder statesman of radio. The fact that he continued his fight was characteristic of the dogged tenacity which was so essential to his success.

III

Let us try now to review the important characteristics which may have contributed to Major Armstrong's creativeness in research. First, and foremost, he possessed a genius and character which was God-given. Placed in exactly the same circumstances, only a very few human beings would have had the capacity to achieve a fraction of what Armstrong accomplished. He was single-minded in his objective in life. He was thorough, very hard-working and indefatigable. When asked how Armstrong managed to achieve what he did, one of his assistants stated that he was willing to spend 23 out of 24 hours of his day concentrating on radio. If ever there was an example which illustrated the cliche that creative research is only slightly inspiration and mostly perspiration, he was it. He would repeat an experiment over and over again with little or no regard of the hour until every peculiar effect was fully explained.

The second important factor in his life was the professional education which he received. While he no doubt benefited greatly from his amateur radio activities before entering college, it was his formal education which matured him professionally. In addition, he came under the influence of a foremost teacher, inventor, and scientist in Professor Pupin who earned the reverence of young Armstrong. By making laboratory facilities available to Armstrong, Pupin greatly furthered his productivity.

The third important factor was the timing of his career. The time was ripe for the exploitation of the vacuum tube. Great research organizations sponsored both by industry and government were not in existence and the individual inventor had a good chance to do significant work. The type of work done by Armstrong as an individual in the early decades of the twentieth century is done now by whole organizations of engineers and scientists. It is correct to state that Armstrong is probably the last as well as possibly the greatest individual American inventor.

Fantastic Capacity To Think In Physical Terms

The fourth factor was Armstrong's fantastic capacity to think in physical terms. It is often said that he was a non-mathematical thinker, but such a statement would have been challenged by Pupin. If by mathematics one means simply the formal writing of symbolic mathematical relationships between quantities, he was indeed non-mathematical. A striking characteristic of his papers is that they are generally devoid of any equations. However, if one means by mathematics the exact science of rigorously following one step of logic with another to describe the whole, not necessarily using symbolism, then Armstrong was a foremost applied mathematician. It has been said that he disdained and distrusted the mathematical approach. However, from personal experience I know that he had the highest regard and respect for those who used the mathematical approach. What he objected to was the use of mathematics for its own sake or the application of erudite mathematics to an incorrect physical model resulting in the prediction of an incorrect performance. He demonstrated this devastatingly with his invention of broadband FM. As an experimenter, Armstrong had the uncanny faculty of observing effects and then assembling them into a logical whole thereby producing a clear concise and correct picture of a particular phenomenon. He demonstrated this over and over again starting with his early description of the performance of the triode, explaining the phenomenon of heterodyne and finally pre-

dicting the effect of broadband FM on noise reduction.

The fifth factor of importance was his ability to inspire loyalty among his colleagues and assistants. Armstrong was recognized by all as an important figure. Yet he retained a modesty and self-effacing character which made all who knew him or worked for him respect and like him. I asked him on at least two occasions to tell me what it was that was responsible for his enormous productivity and success. The question embarrassed him and he evaded a direct answer by reciting certain factual occurrences in his professional life. Never did he play up in any way his personal role. Probably he did not really know exactly what it was that made him the great man he was. His generosity and loyalty towards those whom he felt dealt honestly with him was renowned. At the same time his tenacious opposition to those he felt did not was equally well known.

Youthfulness of Outlook

Lastly, a factor which undoubtedly contributed to Armstrong's productivity was a youthfulness of outlook, a boyish enthusiasm which is hard to define. It was brought out tangibly in a number of his more daring feats such as the memorable climb to the top of the WJZ tower, or his swinging at the top of his Alpine tower in a boatswain's chair to adjust the antenna feed for his FM station. More intangibly, it shone in his eyes when he talked about his work. I shall never forget my last meeting with the Major, some two months before he died. The occasion was dinner at his apartment to which I had been invited to meet a business acquaintance of his who had a research and development proposal which he thought might be of interest to me. The Major was in a good mood. Only occasionally did he show a few flashes of the loneliness which lifelong concentration on his work brought upon him. At the end of a most enjoyable evening, his other guest and I bade him good night in the foyer of his apartment. I clearly remember him as I shook his hand. He was tall, powerfully built, one shoulder drooping slightly, his head bald, smiling his typical crooked smile, and looking a bit tired. But the most striking thing of all was the characteristic twinkle in his eye which belied his age and was like that found in a young man looking forward to another exciting day. Perhaps this was the most important asset of them all.

Major Armstrong died on February 1st of this year. At the time of his death he was in the midst of his greatest battle for FM. Regardless of the rights or wrongs of this or any of his other conflicts, opponents as well as partisans will probably agree that Major Armstrong was the most important creative thinker and inventor of all time in the field of radio and that his passing marks not just the end of the life of a great man but also the end of an era.

Sections and Branches

An Annual Meeting of the **Pacific Northwest Section** was held April 24, 1954 at Oregon State College, Corvallis, Oregon. Section Officers for 1954–55 were elected. These were:

Chairman—M. L. Jackson
Vice Chairman—L. Craine
Secretary—J. T. Norgood.

Some of the topics discussed at this meeting included NSF Sponsored Short Schools, Humanistic-Social Studies, Evaluation of Curricula, Increased Local Section Influence, Accreditation, YET, E.C.-P.D. Meeting and the Meeting of the Committee on Evaluation of Engineering Curricula.

The Triumvirate for Improving and Maintaining Good Teaching*

By R. L. SWEIGERT

Dean of Graduate Division, Georgia Institute of Technology

Before starting on the subject of improving and maintaining good teaching, I would like to raise one question: why is it such a problem to arouse the *active* interest of our college faculties and administrations in the problems of teaching when teaching is our main business? A few of those concerned do have this interest but why should it not extend across the board and involve everyone concerned in higher education. Should not most of our educational activities and expenditures be judged on the basis of their contribution to the educational process?

Before we can take up the matter of improving and maintaining good teaching we need to reach reasonable agreement on the definition of good teaching. I am, therefore, going to present a point of view, backed by statistical evidence, that can form the basis for improving and maintaining good teaching.

There are three direct points of attack on the problem, forming what I have taken the liberty to call, the triumvirate for improving and maintaining good teaching. These are:

1. The training of prospective teachers in the graduate schools.
2. The in-service training of new teachers on the job.
3. The evaluation and recognition of good teaching all along the line.

The first two provide the necessary preparation (now largely left to chance) for those entering the teaching profession and the third provides for maintaining good teaching through evaluation, through a careful study of a teacher's effectiveness each year, and through provision for proper recognition of that effectiveness. I believe everyone will become more vitally concerned and interested if a program for improving and maintaining good teaching becomes established even though it may have many imperfections. *Positive action is needed, and administrators must lead in this positive action.*

Coming back to the point on the need for an understanding of what constitutes good teaching it is apparent that if we are to do any effective training in graduate schools, in in-service training programs, and if we are to evaluate good teaching, we have to know of what good teaching consists.

In the teaching process, we are not really concerned with teaching per se but with learning as reflected in changing performance. Without learning having taken place it does not make any difference what the teacher or administrator thinks about the quality of the teaching. There is no teaching in such a case.

How does learning take place? Does it come directly from lectures, from discussions, from instructor-centered class operation, from student-centered class operation, from a good voice, good dress, or from other things or combination of things? If, when learning takes place, we are modifying our nervous system

* Presented at the Annual Meeting of ASEE, University of Illinois, June 17, 1954.

relationships as indicated by the psychologist, and if that is basic to a change in behavior or performance, then how are such changes brought about? Changes appear to be brought about in the nervous system by activity. That would mean that learning takes place through activity of the individual who is trying to learn. Changes in the nervous system response cannot be brought about directly by anything outside the individual, such as the instructor for example. Thus we come to the conclusion that learning takes place through the activity of the learner and that there can be no such thing as direct teaching. Teaching goes on when learning takes place and learning takes place only when the individual is active. We must realize that the learning will be in line with the particular activity going on since only that portion of the nervous system concerned is being primarily affected. Another generalized way of stating the above is that all education is self-education.

Basic Concept

This basic concept needs to be understood and accepted if we are to effectively improve teaching through the triumvirate. It plays a strong and important part in all three phases, in establishing not only a basis for the material in training programs in the graduate school and on the job, but also in the conduct of such programs and in any plan of evaluation of teaching.

If the above is accepted as basic, then it becomes evident that what constitutes good teaching involves producing activity of a kind that will advance the performance of the student in a given field in which we are trying to improve his proficiency. The character of the performance needs defining because that will determine the kind of student activity necessary.

What are the factors involved in this change in performance or in the learning situation that are mainly dependent upon another individual, the instructor? Fortunately we have the results of at least three comprehensive statistical studies; one made at an undergraduate college with no research or graduate work; one made at a large liberal arts college, part of a large University where undergraduate, graduate work, and research are involved; and a third made at a middle-western university where a study was made of graduates who had been out of college for ten or more years.

Through a study of the above investigations made in a graduate seminar and with the help of graduate students, many of whom had teaching experience and who had served on faculties at other institutions than my own, we arrived at four prime influencing factors which we call the four elements of good teaching. The studies gave enough data to make it possible to rank the elements in order of importance, but this does not imply that all four are not of major importance.

These elements are:

1. Motivation. (Every act and every word of the instructor motivates or discourages. Each individual student must be motivated. This brings in the concept of individual differences. An understanding of the feelings and reactions of others is essential.)
2. The ability to explain. (This also affects motivation and can be used as an effective motivating device upon appropriate occasions.)
3. Competence in the field. (Must be fully adequate for the level of student activity involved.)
4. Organization. (Makes clear to the student, curricular, course, and assignment relationships. Provides clear cut and understood objectives for the course and the assignments in the course. Provides effective learning situations into which the student can enter. Provides appropriate learning materials.)

It would make a too extensive discussion to go into great detail on each ele-

ment but I believe enough has been given to make clear what is meant by each element.

If a man learns only by his own activity, both physical and mental, that is if all education is self-education, then we might examine the four elements in the light of this point of view.

The learning situations, into which the student must enter, are provided through the organization of the material of a course. A poorly organized course will not provide good learning situations and without fully satisfactory learning situations, effective and efficient learning cannot take place.

In the learning situations, if time were unlimited, it might be advisable to let the student work himself out of his difficulties because he learns by his own activity. But since time is very definitely limited, the student may need help at certain difficult places. He can be helped through an instructor's ability to explain, and in the explaining, the facts that the student learns only by his own individual activity and that he needs motivation must be kept strongly in mind by the instructor.

It is apparent that to set up excellent learning situations and to be able to explain, the instructor must have the necessary degree of competence.

Motivation is Essential

With situations set up to accomplish the functions of learning, the student will need to enter into the situations that are planned by the instructor, for learning to take place. This calls for the best in motivation. Without motivation of the student the other factors cannot properly function. If the instructor provides the best possible learning situations, has the competency in the field necessary to plan the situations, has the ability to answer questions in a manner to produce the most learning by the student, and provides the strongest possible motivation to produce the greatest appropriate individual activity in the field being studied, the statistical studies indicate and my own experience indicates that maximum learning takes place and if maximum learning takes place then the best job of teaching is being done.

Because all human beings (including both students and instructors) are different, we never have ideal performance. Individual differences mean that when the instructor has to deal with more than one student at a time as he has to do, even if the elements are accepted as basic by the instructor and every attempt is made to have the best in each element, he will have to compromise and attempt to have the best over-all effect for the group. The ideal situation appears to be one student at one time for one instructor. Studies which I made a number of years ago and covering several years indicated that various methods and techniques could be used to reach fairly effectively about 80% of a group of students. When changes were made to reach as many of the remainder as possible, some of the original 80% were always lost so that I was unable to greatly exceed 80% except by one device and that was by giving individual attention.

The same instructor with varying student groups from term to term will not be able to accomplish the best results that he may be able to accomplish every term. But I firmly believe that an instructor who recognizes and works to make the elements as good as possible will end up doing the best possible over-all job of instruction and a good plan of evaluation should show this. The instructor who can not or does not set up good learning situations, who cannot explain satisfactorily, and particularly who cannot motivate students or even may produce a discouraging reaction in the students will not have effective learning take place and he would be classified as a poor teacher.

We will now give attention to the relationships between the four elements and the three phases for improving and maintaining good teaching.

The first phase is the training of prospective teachers in the graduate school. I do not propose to suggest a whole program of teacher preparation but merely want to point out some things that are involved if the four elements are accepted. If we learn by our own activities, then the only way we can learn to teach is to teach but that does not mean throwing a young man blindly into a classroom filled with students, and I believe that has been somewhat the national practice.

There are some things which the prospective teachers will do well to recognize. Teaching is an art and one can only become proficient in an art by an intelligent practicing in it. That limits the extent of benefits possible from formal course study. The graduate school therefore is limited in what it can do effectively, but an examination of the elements indicates there may be some things that are worthwhile doing that will help produce a better teacher.

Can we develop a man's abilities to produce motivation in others through formal course work? That would appear very doubtful in the light of the way we learn. One, in my opinion, learns how to motivate others for learning purposes through the actual handling of students and being wise enough to analyze how his own personality and actions impinge upon the student and what effect is created. This calls for actual teaching and if it is possible to use graduate students interested in education under supervision of someone who understands good teaching and who can use it in his own dealing with prospective teachers, then it becomes possible to help the coming teacher understand himself in relation to students. This could be called a teaching internship. However before taking up the internship, the prospective teacher could take some formal work in the psychology of learning and of motivation both of which could help him start his development as a teacher and could supply a basis for self-appraisal.

Ability to Explain

The development of the ability to explain lies in the actual practice and study of results of one's own explaining. This means actually teaching under supervision.

Competence in a given field is a prime objective of graduate study and is already being well taken care of by the various subject matter groups.

Training in organization as defined here must be carried on by actual preparation for actual teaching, again under supervision. Factors affecting motivation, whether we desire them to do so or not and growing out of organization are, tests and examinations, other devices used as a means of measurement, and the grades themselves which are the numbers or letters taken from a measuring device. A study of tests and examinations and a study of educational measurements therefore would seem to be desirable. If we were to include a study of student personnel problems, I believe we would have included nearly all of the formal study that would be of value. The studies above could be presented through formal courses or preferably through a series of appropriate graduate seminars. Through the seminars and their handling (the seminar itself should serve as an excellent example of good teaching), covering the four topics mentioned above, and through a limited, and in a sense, an introductory amount of apprenticeship teaching under appropriate supervision, the graduate schools could make their contribution to the improvement of teaching.

Since we learn to teach by teaching, a continuation of the training in the graduate school is called for, for perhaps a year after a young man is on the job. This program should be developed in such a way as to enable the young man to bring the four elements into full play for the best learning results. It might involve a review of the teaching background introduced in the graduate school. This could be followed by a considera-

tion of any items of particular importance to the institution concerned. The in-service program might be completed with closely supervised teaching in which the same type of relationship might exist between the young instructor and his supervising professor as exists between the doctorate student and the professor who directs his research.

I feel confident that a young man who has taken the seminars mentioned, who may have had an opportunity to have served in apprenticeship teaching for at least one term, and who has received special attention through an in-service training program would end his first full year on the job in a much better position to develop himself into a good teacher.

With these two programs worked out to a fully satisfactory operating condition, we would be providing the means for improving teaching but not maintaining good teaching. We must have proper recognition and incentives to maintain good teaching and to have these we must first have evaluation.

The four elements can serve not only as a basis for setting up training programs but also as a base for a workable plan of evaluation that would not be too cumbersome or so detailed that it would lose significance. The evaluation can not only serve as the base for recognition but also as a means for each individual to have a measure of his own development as a teacher. It can provide the information which every teacher needs to know about himself to enable him to continue his development to a still higher level if possible.

Before anyone's teaching can be evaluated, appropriate information about the teaching must be available. Without such information no one's teaching can be evaluated. It is the acquiring of the essential facts that is the problem of evaluation. If the facts are available then someone capable of doing so can proceed with a plan of evaluation. The facts to be gathered must of course be in line with the plan of evaluation.

Four Elements

The four elements provide the character of the information that we need. We need facts on each of the four elements if we accept them as the backbone of the educational process.

The question can be raised, who can report on motivation? The students are on the receiving end. It appears to me that they are the prime ones, as a group, to give information on motivation. An individual student has some idea in regard to whether or not he is being affected in certain ways in the course and with a plan set up, he can render a valuable report. If motivation is accepted as the first basic element then we need a scale from which ratings can be determined. I would not attempt to discuss that here; that is an additional problem, one with which the psychologist could help us.

The second element is the ability to explain. Again the student is on the receiving end. The question is not whether the professor understands what he is explaining or that another professor understands; it is whether or not the student understands what the professor is explaining, and if the student does not understand then the explanation is lost, and educational benefits are lost. The effective use of explaining involves motivating the student to think. The student is the one that can report best on explaining. Ability to explain is placed in second place, the relative position coming from the statistical studies already referred to.

The third element is competence in the field. This in my opinion can be reported upon by a man's colleagues in the field. Advanced study and scholarly work provide additional information.

The fourth element is organization. Under this item comes the promulgation of the objectives of the whole course and of each individual assignment so that the student knows where he is going and why. Also included under this item are the situations which it is necessary for the

instructor to set up in order to provide learning conditions. I believe data on this element can be obtained by an examination of tangible materials of the organization (teaching materials including tests) which any instructor should have available for examination as well as from some reporting by students. Thus the obtaining of appropriate information in my opinion, depends upon students, upon a man's colleagues, upon a man's scholarly record, and upon an examination of the material which the man prepares for use in his teaching.

If a workable scale can be established under each of the first two elements, a scale that can be used by someone carrying out the evaluation, if one can be set up by which a man's colleagues can provide for the evaluating of competence in the field, if provisions can be made for the evaluating of his teaching materials and other factors affecting organization, and if all results can be combined, arriving at one over-all rating, I believe we would have a basis for the evaluation of good teaching. If we can arrive at such a base then it can form the foundation for recognition and for promotion in rank and salary in which teaching will play its full part. This will do more to focus the attention of faculty members on good teaching than anything else that I can think of and it can provide the best and perhaps the only way to maintain good teaching.

Evaluation

Evaluation of a sort goes on all the time but it can hardly be called a sound valid and reliable evaluation in so far as teaching is concerned. We now have a kind of evaluation going on more or less continuously based upon the chance reports of a few students and faculty members. In the case of faculty members, they may only transmit chance reports that originated originally with students. I do not see how there can be real and fair evaluation without planned reporting and the reporting should be set up on a sound basis that will make the results of the reporting of maximum dependability, over-all accuracy, and utility for evaluation purposes.

Let us have a planned reporting, followed by a sound plan of evaluation which can lead to real recognition for the prime work of the college, the work of teaching.

College Notes

An international meeting of over 200 educators and engineers was held at **Clarkson College of Technology** October 6-8. William G. Van Note, college president, announced that the American Society of Mechanical Engineers and the Engineering Institute of Canada have accepted the college's invitation to hold a convocation on "Trends in Mechanical Engineering Education." Among the topics to be considered during the convocation will be "Can Present Mechanical Engineering Curricula Be Improved?" "Dangers of Overspecialization in the Curriculum," and Post-Graduate Education in Education."

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Harry L. Daasch has accepted appointment as a professor in the Department of Mechanical Engineering at **Colorado A & M College.** He will act also as department head during the next two years while the present head is serving for the College at the University of Peshawar, which it is sponsoring under an F.O.A. contract.

Recognizing and Rewarding Good Teaching*

A Preliminary Report of the Committee on Recognition and Incentives for Good Teaching

By R. W. SCHMELZER

Chairman of Committee; Assistant to the President, Rensselear Polytechnic Institute

In an Abstract Report of the Stanford University Committee on Evaluation of Engineering Education, the following statement appears:

> . . . there are only two important factors in the educational process, the student and the teacher. The rest—curriculum, administration, structure—are unimportant except as they influence the effectiveness of student or teacher.
>
> The raw material, the student, is to considerable extent out of our control—the second factor is the one we must work with. We shall have improved education of engineers only when we have more good engineering teachers working in an environment in which they can function effectively.

The Committee on Recognition and Incentives for Good Teaching was charged with examining the role of good teaching per se as it affected the status of the faculty member. It is still in the process of its examination.

The committee is a large one so that a great deal of its correspondence is done with the aid of a mimeograph machine. Since it is relatively easy to grind out a few extra copies of each item of correspondence, the officers of this Society were unfortunately kept too well informed about the discussions going on between committee members. Although no conclusions have yet been reached by this committee—with the exception of one or two areas of almost unanimous agreement—the officers felt that the ideas of the committee had reached a point where they might be presented in a meeting such as this so that additional ideas and opinions could be obtained. This, then, is a report of the opinions of people both within and outside of the committee about the recognition and rewarding of good teaching.

Almost from the outset, the committee addressed itself to the problem of whether it is possible to measure objectively the results of good teaching. In connection with this problem, it had the advice of the Chairman of the ASEE Division of Educational Methods, and it also had the advice of two distinguished psychologists in the field of personality measurement. One of these, Professor Gordon Allport, Professor of Psychology at Harvard University, said, "My guess would be that there are so many ways of being a 'good' teacher and so many ways of being a 'bad' teacher, that no uniform scale is possible . . . it might be feasible to develop a record or rating form that an administrator might use to keep track of specific attributes of teaching that would help him reach an over-all judgment concerning the excellence of a given instructor. Such a broad (rating type) of guide might be better than the 'intuition' that is now employed by administrators, but it will still fall far short of the mathematical formula that some enthusiasts might desire."

* Presented at the Annual Meeting of ASEE, University of Illinois, June 17, 1954.

Professor Hadley Cantril, Professor of Psychology at Princeton University and Head of the Office of Public Opinion Research, said, "I quite agree that the problem is perplexing and has many variables. However, I do think that there are certain aspects of being a 'good teacher' which are generalizable and might form the basis of some further inquiry. . . . Obviously, there are enormous personality variables here that I suspect can never be 'taught' or 'improved' if a teacher just happens to be built the 'wrong' way for his particular profession."

Dean Sweigert and the Educational Methods Division have already done much to clarify ideas concerning the recognition of good teaching, although in the committee for which I am reporting, there are some reservations as to the significance of student rating of instructors. But before areas of difference are discussed, it might be well to mention areas of agreement.

First of all, it is accepted without question that the good teacher must of necessity be a good person. He must have wisdom, honesty, interest in people, a knowledge of his subject, and so forth. But desirable as these qualities are, the possession of them alone does not automatically make for a good teacher.

Qualities of a Good Teacher

Professor Cantril lists three aspects or qualities of being a good teacher to which the committee subscribes. These are:

1. A real ability on the part of the teacher to understand the purposes of his students; what they are trying to get out of the course; why are they taking it; how can their personal purposes be brought into the teaching?
2. The use of concrete illustrations at the beginning of discussion on almost any problem no matter what it is; arriving at abstractions only fairly late in the discussions. . . .
3. Indicating at the beginning of a course what the course is all about—then giving the course—and then at the end making a fairly thorough review of what the course has been all about—that is, trying to wrap it up in a package.

The committee also recognizes that teachers are employed to produce certain specified, desirable effects. One of these is introducing students to a subject. Another is carrying them along in the subject in the intermediate stage. And still another is carrying them up to the frontiers of knowledge in a subject. A teacher who is adept in producing one effect and performing one function with students may be quite ineffective if asked to produce other effects. Similarly, some teachers may be particularly stimulating to good students but may have little or no beneficial effect upon average or poor students. A wise administration recognizes these differences and uses its teachers where they can be most effective.

As Professor Glenn Murphy of Iowa State College says, "The objectives of a freshman course in engineering drawing are different from the objectives of a senior course in aeroplane design. Consequently, if absolute and not relative measures of performance are desired, different sets of specifications must be used in evaluating the teacher's performance in each course. We all know of teachers who are far more successful in teaching one group of courses than another.

"In establishing what we should expect from a good teacher in a given course, we should take into account the fact that each course has four types of objectives. In each course, we want the students to acquire certain bits of factual information that will be useful later, we want them to acquire certain manipulative skills (such as using a slide rule or steam tables), we want them to develop an understanding of basic principles and their applications, and we want them to develop whatever native ability they may have for thinking."

Dean Hazen of M.I.T. in "A Letter to a College President" says, "We are skeptical of the man whose course has not changed very appreciably in the last ten years in orientation, outlook, and selection of subject matter." To be effective in communicating with growing minds, the mind of the teacher must also continue to grow.

Obviously anything which challenges the mind of a teacher, which causes him to work to the best of his ability in his chosen field, is not only desirable but is a necessity if we accept the truth of the preceding statement. Here then is the real role of research, of publication, and of consulting in the teaching-learning situation. All of these activities demand the best efforts of the teacher; they keep his mind razor sharp; enable him to stand as an equal among his peers and thus give him confidence and self-esteem; and they enable him to bring to the classroom a wealth of current illustrative material.

An article on university research in a college alumni magazine states, "The climate of the graduate school with faculty interested in contributing to knowledge and organizing advance material for study, with students anxious to try out their own ideas, seeking council of those already well versed in research, keeps in balance those factors so necessary. . . . Not only is the educational effort of the professor made more successful, but this is also the best method by which the professor may secure professional recognition." Is this latter statement that "this is also the best method by which the professor may secure professional recognition" necessarily true? And, if it is true, the committee asks, should it be?

A Teacher's Profession is Teaching

Professor Nudd of Cooper Union has strong convictions on this subject and writes,

> A teacher's profession is teaching. A teacher should be an authority on teaching. The significant field of his scholarly attainments is teaching. His significant research is in teaching. Judgment of his attainments which are significant to his reward for employment as a teacher should come from peers who are teachers. Adequate knowledge of the subject taught is the least of our problems in obtaining effective teaching. The confusion in evaluating a college on the basis of its teachers' erudition rather than on that of its students is responsible for a large share of our difficulties. There may have been times when lack of knowledge of the subject taught was an important handicap to many teachers in our engineering schools, but this is certainly not true today. Our problem is to induce teachers to provide effective experiences for the students. Teachers who have won distinction in activities other than teaching should not be rewarded as teachers unless they have matched the non-teaching activities with effective devotion to teaching.

Let us assume for the time being that if it were possible to do so, teachers would receive recognition and rewards primarily for the excellence of their teaching rather than for their associated activities, important as these might be. How then is the quality of the teaching to be recognized? By whom and in what manner?

As might be suspected, the members of this committee are much less unanimous and much less definite in regard to methods of recognition. The growing custom of student rating of teachers is regarded by the committee as of value chiefly to the teacher himself and not to department heads or deans. Several members of the committee feel that student ratings tend to give undue emphasis to entertainment value, geniality and other personality traits, rather than to more significant and possibly more lasting values in teaching.

It is, however, certainly true that motivation plays a most important part in the teaching-learning process. Obviously, the teacher who discourages or kills motivation on the part of his students is a menace and should not be tolerated. Students are, therefore, in a position to report upon motivation. They are also

in a position to report upon the suitability of the course to their stage of learning—that is, they are well able to report whether the course repeats unduly what they already know, or whether the course assumes that they know more than they actually do.

The ideal situation would be to have an assessment by the graduates five or ten years later. But such an assessment would be extremely difficult to carry out and it frequently might no longer apply to the existing situation.

There is, of course, one excellent way for a teacher to find out for himself what his students think of the value of his own teaching. He would, in order to try this experiment, need the cooperation of the members of his department and the consent of a dean or two.

It is simply this. After his course has been running for, say, four weeks, let him announce to his class that the final examination in the course will be written and graded by a committee of the college faculty—that he will have no hand in either the examination or in its grading. He, however, will plan to meet with his students at the regularly scheduled times, but that he is giving them an outline of the material to be covered by the course and that there is no obligation on the part of his students to attend any further classes. They may come if they find the classwork helpful or they may stay away and study on their own.

Gauge of Teaching Effectiveness

All the teacher has then to do, after having made this announcement, will be to watch class attendance the way a theater manager watches his box office. If the attendance is good, the students will undoubtedly feel that they are getting something out of his teaching. Of course, a few students may attend out of sheer superstition and a few others out of sheer habit, but by and large if students feel that there is no need to attend and that there will be no retribution for not attending, their presence or absence will be significant. It should be a far more accurate gauge of teaching effectiveness than any student-faculty rating sheets yet devised.

The foregoing is not meant to imply that teachers should play a secondary role in education in favor of impersonal final examinations. The committee believes that the engineering student needs the teacher's aid in creating situations for learning where the emphasis is not on memorizing and testing but on practice. In these situations the teacher can observe how the student analyzes and attempts to solve the problem, with the teacher simultaneously giving aid and encouragement and evaluating progress. Because engineering is creative and productive, examinations which merely test the amount of information the student has acquired and memorized may fail completely to evaluate properly the creative and productive engineering ability of the student.

Although students as recipients of teaching should be in a position to evaluate it, in actual fact, recognition and reward for "good" teaching can only be brought about by the people whose responsibility it is to recognize and reward teaching; that is, by department heads and deans. This, in the opinion of a majority of the members of the committee, is their specific responsibility. And they already have at hand a great many ways of measuring teaching effectiveness. They have outlines of courses, examinations written by the teacher, teaching devices and aids that are particularly effective and that receive favorable attention by the teacher's colleagues. Then, too, there is the general respect that the teacher receives from colleagues and teachers in his field. Furthermore, there is the quality of mind and performance that he demonstrates in his university duties as well as his publications, his research accomplishments, and his industrial relationships.

Dean Jamieson of McGill University says that he believes that "teaching quality is of paramount importance in

the undergraduate years, and that 'good' teaching *can* be assessed, albeit not quantitatively. The teaching of undergraduate courses, as a major interest for all members of the staff, must carry adequate reward by way of salary and position in the profession. This does not dissociate the good teacher from creative activities. The expression of his development lies in his stimulating and progressive teaching. Research will have its place in his work, but not always a major place. We must not give undue weight in the way of incentives, to graduate teaching, research, published papers and so forth."

This statement by Dean Jamieson is a fairly accurate summary of the thinking of the committee at the present time. Throughout all of the divergent opinions cited in this report, one unifying theme appears. That is the concept of good teaching resulting from creative activity on the part of the teacher. The one important prerequisite for good teaching appears to be a growing mind. Whether that mind is growing as the result of a search for better teaching methods, for more knowledge, for better methods of applying knowledge, or for various other reasons is apparently not so important as the fact that the mind of the teacher is growing. When the mind stops growing, it starts dying.

Further Investigations

Your committee would like to make further investigations regarding two somewhat related points. These are: (1) to continue to determine whether it is possible to measure objectively the results of teaching, both good and bad, and (2) to study the present methods of rewarding good teaching per se.

The question of teaching ability versus knowledge is one that must be solved by each university and each department in its own way. So much has been said upon both sides of this issue that the committee approaches this problem with great reluctance. Certainly no one would hire as a guide in frontier territory a person who had never been there. On the other hand, undergraduate education in engineering and science travels through fairly well-explored regions, and many people who have never been to the frontier are completely familiar with these regions. These people serve not only as adequate but frequently as excellent and inspired guides.

There do exist techniques for creating a greater awareness about certain aspects of our national life and institutions. These techniques have been used quite effectively in the fields of propaganda, advertising and public relations. Perhaps what is needed in relation to the question at hand—that of stressing the importance of teachers and of the teaching-learning situation—is simply to give it more of an airing than it has had in the past. Perhaps, by the use of some of these techniques, we need to create a climate of opinion so that the man who devotes himself primarily to teaching won't feel apologetic about it—won't feel that he is not a valued member of the university community; won't feel that he is playing second fiddle to a researcher or a writer of textbooks; won't feel that it is somewhat futile to devote his efforts to making himself as good a teacher as he possibly can. Perhaps, just by taking thought, we as a Society, can add a cubit * to the stature of the teacher.

* 18".

The Munificent Gifts That Lead to Good Teachers*

By E. C. THOMA

Associate Professor of Civil Engineering, Purdue University

It would be unjust to limit these munificent gifts to engineering teaching alone for most certainly all teachers will agree that it is the generous giving by most teachers to all of their students that has aggrandized this oldest of professions to all mankind. Teaching is the root, the beginning, the source of growth of Man. So it was with the Ancients and so it is with us. Someone—a mother, a father, an elementary or high school teacher, a college professor—has been a sower of seeds and a generous counselor on the fertilizing of ideas so that the sprigs of Man could take root and grow.

But let us be more specific; let us view these roots that our gifts of good teaching will develop. Naturally these gifts will be as I see them and, therefore, somewhat opinionated rather than built wholly upon facts. Most assuredly teaching is an individual portrait and what seems best for a certain personality may not blend to the color and characteristics of another personality. However, we must all concede that every good teacher has developed certain traits of common good. It is these traits—these munificent gifts —I shall discuss.

I. *The Teacher's View of His Profession*

Effective teaching can be influenced through an appreciation by all teachers that, regardless of the subject each teaches, their goals are akin. It was once said, "Any teacher must appreciate that a more complete education—sciences, arts, humanities—is best achieved under a unified program rather than fragments through departmental learning." Therefore, an attitude of 'for the good of the whole' must preface a teacher's individual thinking about his profession.

This professional attitude is determined to a large extent by the administrators—the deans, the department heads, the section supervisors. I have been most fortunate in this respect—from the very top to the very bottom of the administration ladder. It is a heritage due every teacher. Professional esprit, the zest and the zeal to do a good job, must be spotlighted by those who hold in their power a small measure of another's destiny.

II. The Teacher's View of Himself

Like any other successful individual the teacher must have confidence in himself, his school, his profession. Dean Harry J. Carmen of Columbia College, Columbia University, ably expressed the traits so necessary in a teacher when he said that teachers should be "persons of attractive personality, insight, sensitiveness and prospective—persons who have a happy disposition and a sense of humor and who have an urge to be guides, philosophers, and friends of students. . . ."

Certainly we all agree with Dr. A. D. White's report made in 1866 to the trustees of Cornell University to the effect that good teaching must develop mental discipline—the discipline of keenness, precision and breadth of mind. A lack

*Presented at the Annual Meeting of ASEE, June 17, 1954, University of Illinois.

of breadth, so goes the report, "fails to make men." If the young men and women of today are to be the leaders of tomorrow, the teacher must have moral strength, an inquiring mind, an inspiring spirit and a watchful eye so that he can direct the development of mental discipline.

Education is the gathering of factual information and then employing it to a creative end. Therefore, education is a process of self-learning and self-thinking. The good teacher is his own best student. The good teacher—the effective teacher—is one who stimulates the student to be the teacher of himself. Certainly a student must have guidance to distinguish between facts and opinions. However, this guidance cannot be the type whereby the teacher marshalls the development of individual thought.

When the effective teacher takes a periodic blood count on his students, he unquestionably can number these growing organisms that he has helped to sow: (1) sufficient factual information to keep the students' self-teaching on the right road; (2) self-teaching stimulants—spirit of inquiry; (3) confidence by the students of their ability to teach themselves; (4) integrity—a moral code of their own which is above reproach; (5) a strong character; (6) a desirable personal philosophy; and (7) a standard of achievement second to none.

III. The Teacher's View of the Student

In the student the teacher sees youth and spirit, that tangible product of Man that spells continuance of growth and progress. The teacher sees reflections of himself in an era some years past. The good teacher casts these reflections forward to light the path of his students with those very things he saw and sought for himself—an individual of inquiring mind motivated by sound character to worthy and attainable ambitions. But how is the good teacher going to be sure that the students stride toward that goal? The good teacher remembers that:

(1) His classes are composed of as many individuals as there are students enrolled;

(2) Only by his own enthusiasm of spirit and interest will he be able to inculcate in every student the desire to learn his subject's related position to the end product—an education;

(3) Only by a reasonable amount of effort, by sweat and determination, can all students reach the top of their individual ladder of success. Therefore, a sternness to do the job at hand is necessary. College students respect and follow the instructor who treats them for what they are—adults. The instructor who permits the back-slider to slide unbraked, who permits the student to commit a "breach of educational contract" without being admonished, who establishes a set of procedures and rules for educational conduct and then ignores them—all these and similar attitudes, will lose the respect and confidence of his students.

(4) Every individual thinks himself to be an important person in the world. Therefore, good teaching strives to encourage and build personal confidence—bearing in mind, however, that the confidence to be achieved is not a cocky, obnoxious, "I can do no wrong" type.

(5) Good teaching encourages each individual to seek his own level of attainable goals. An alidade is the vernier of an optical instrument. I like to think, then, that the trait of displaying good judgment is the vernier or alidade of that optical measuring device, the mind. It only stands to reason that kindness, fairness, candor, tolerance, understanding and courtesy are displays of good judgment in finding avenues of approach into the inner sanctorums of the individual student.

And so one could go, on and on. In attempting to define the labors of good teaching we could say it is the striving to develop within each student a spirit of self-inquiry—an intellectual curiosity, if

you please—to obtain a knowledge of concepts and principles reinforced with the ability to communicate to others in a courageous, sincere and industrious fashion a solution developed from a logical analysis of the precepts involved and synthesized to the particular problem under consideration.

We now can appreciate what Jacques Barzun meant when he said, "The ramifications of teaching are so numerous and so singularly significant that a true concept of the ideal entity often is lost." Reasonable as this statement may be, we must admit, too, that our teaching technique can be evaluated with a pointed self-inquiry; namely, have my teaching procedures helped build that ship of destiny—CHARACTER; rigged its sails of mental growth—INTELLECTUAL CURIOSITY; and seeded a hurricane to assure it motion—AMBITION? If so, the munificent gifts or traits of the good teacher are yours.

College Notes

Astronomers and electrical engineers at the **University of Pennsylvania** have joined forces in a concerted program to pioneer new electronic methods of observing the stars, Carl C. Chambers, vice president in charge of engineering affairs, announced recently.

To foster the development of new observation aids, the University has established a "working partnership" between its Department of Astronomy and its Moore School of Electrical Engineering.

* * *

John Fyfer Calvert has been named Professor and Head of the Electrical Engineering Department at the **University of Pittsburgh.** Dr. Calvert has been professor of Electrical Engineering at Northwestern University since 1938 and has served as chairman of the department since 1939. He was formerly associate Professor in Electrical Engineering at Iowa State College from 1936–38. From 1925 to 1936 he was associated with the Westinghouse Electric and Manufacturing Company. During this time he took part in the Westinghouse program at the University of Pittsburgh serving as a graduate lecturer.

* * *

The appointment of James Michalos as Chairman of the Department of Civil Engineering at **New York University's** College of Engineering, was announced by Dean Thorndike Saville. Now Chairman of the Department of Civil Engineering at Iowa State College, Dr. Michalos replaces Thomas C. Kavanagh, who has resigned to work with the firm of Praeger and Kavanagh Engineers on a full-time basis. Dr. Michalos is an authority on structural analysis, mechanics, and design theory.

Philosophy of the Cooperative Program*

By PROFESSOR CLARENCE E. WATSON

Chairman, Dept. of Industrial Relations, Northwestern University

The basic philosophy of the cooperative program lies in its experience value. The professions of law and medicine, for example, both require rather lengthy periods of apprenticeship before the professional society will recommend a man for public practice. If, then, our training of an engineer is to be complete, we must provide first hand experience in industry with the men and machines with which he will work. Such work experience challenges the student with events which hit hard at his personal life and habits. This personal challenge cannot be attained by an academic curriculum alone. By this method, as in no other system of formal education, students are brought in direct contact with the American system of free enterprise.

Until the time of cooperative work, the student's education has been of an "individualized variety." He has been individually tested, graded, and ranked among other members of his class. Competition has been the keynote, and definite rewards have been paid in the form of grades and subsequent honors. Now, in his cooperative work, he begins to realize that upon joining industry he becomes a part of a most active *team,* be it large or small. As a member of this team, he finds that the tail cannot always wag the dog. A "great" idea oscillating within his own mind does not necessarily effect sympathetic vibrations in the minds of management or other workers. This is often quite a shock to some students.

Teamwork

If there is one thing the cooperative program emphasizes and teaches the student, it is TEAMWORK. One of the officials at the A. O. Smith Company in Milwaukee puts it this way. "None of us can know it all. We can't be thoroughly familiar with all of the many phases of our many sciences and techniques and have the practical know-how of all of our manufacturing processes. There just aren't enough hours in the day or days in our lifetime to permit it. But we can become well informed in one or several spheres and learn as much as we can about the others—at least to the extent that we recognize there is much we don't know and then call upon those who do know to help us. This is team work. It is the priceless ingredient in all present day accomplishment, multiplying by many fold the relatively limited power of an individual. It is the spirit of tolerance of another's ideas or suggestions. You never know when the other fellow may come up with a crackerjack of an idea which you may never have thought about. It is the spirit of patience you show towards the slow thinker who may be basically well informed in another field and able to help you tremendously after he finally gets the idea. It is, in part, the insight you may have into the reaction of others and the ability to get your idea across and make him think it was his. It is the skill with which each member of the team plays his own position and pitches in to help a weak member when he falters. It is the spirit of democracy bowing to the decisions of the majority.

* Presented at meeting of Cooperative Engineering Education Division, ASEE, University of Illinois, June 15, 1954.

Then after the plan of the majority has been adopted, pitching in with all your might to make it a success. It is the philosophy that no man wins when the team loses but everyone wins when the team wins. It is a little bit of a lot of things—a rather complex concept when you break it down into its elements but very simple when stated as 'a group of people pulling together.'" The cooperative student has this impressed upon him early in the game.

The transition from college to practice for the traditional graduate has been likened to an abrupt shift from high gear into low. The graduate comes out "rarin' to go." For the past few months he's been king for a day. Pampered by recruiters and accustomed to expense-paid trips, he sees a bright future with a successful engineering career ahead. He tackles his first job with enthusiasm, but soon finds it growing repetitious. There is a sense of suddenly arrested progress. He begins to feel that he has learned all the job has to teach and wants to move on to a new assignment, as he did in college. He wants to make a showing, quickly, and in his own name. Where he came from, men were judged that way, as individuals. He may fail to see that he is now engaged in an almost unbelievably intricate piece of teamwork, where most of the brilliant individualists are headed toward one-man jobs and where the chief prizes are handed out for contributions to the work of other men. In this new and strange environment he is likely to lose both the impetus and the sense of direction for any effort to get on with his education and to fall into the habit of being content merely to assimilate the day's experience without conscious intellectual effort.

Competitive vs. Cooperative Thought

What I am trying to point out is that there is a marked contrast between the type of competitive thought provoked in a classroom, and the type of cooperative thought which is so necessary to succeed in industry. There is need for helping students to realize this difference and the Cooperative Plan helps to do this.

Professional careers, differing widely in their demands for specific techniques and branches of learning, are alike in one respect; success in any field depends upon ability to cope with the multitude of diversified problems which arise continually and require rapid and accurate solution. The Cooperative Program is invaluable in the early development of such ability.

The value of an educational process is not to be measured alone by the quantity of information which it imparts, but also by the flexibility and versatility which it develops. The vital requisite is a disciplined mind, with the perspective, the judgment, and the ingenuity necessary to derive the greatest possible value from the information available. Consequently, it is of the greatest importance that the most strenuous efforts be devoted to creating a facility for clear and logical thinking, for the proper orientation of the student's point of view and the conditioning of his mental processes. Industry can play an important part in this orientation.

The engineering profession endows its members with a deep social and moral responsibility. The engineer must satisfy the demands of society for an ever-increasing standard of living, using the researches of pure science to produce, through industry, human benefits. In order to undertake successfully such a task, a man who would call himself an engineer must understand: (1) The scientific method of thought and the natural laws of science. (2) The organization and ethics of industry. Industry and commerce characterize much of American culture. By their proper union with education, even greater achievements than in the past may be expected.

Balanced Training

The Cooperative Plan reflects this basic philosophy. It is a coordinated program of alternating work and study. Employ-

ment in industry is a regular, continuing, and essential element in the educational process. The objective is balanced training—an opportunity for the engineering student not only to learn but to practice during his impressionable years.

Cooperative education achieves the objective of an effective program of engineering training in the clearest and the most comprehensive way. The student looks at the field of engineering not only from the academic viewpoint of the thinker who devises machines and methods, but also from the practical viewpoint of the doer who translates them into action. The combination of theoretical training and practical experience invites and encourages a correlation which may not otherwise be possible or expedient, and which contributes considerably to the value derived from each. The cooperative student is spared the unsatisfactory experience of carrying through to completion his academic training before he is given an opportunity to put any part of it to the test of practice. With the principles taught him in class and the laboratory fresh in his mind, he takes his place for a brief period in the midst of industrial activity. Here the broad understanding of practical procedures is impressed upon him. His period in industry completed, the student returns to college and finds that his academic work assumes a new and interesting significance. Combining theoretical training and practical experience encourages the student to correlate the two. The perspective gained should enable him to enter industry a more mature and understanding person.

Knowledge is a Mode of Doing

The Cooperative Plan teaches the student to deal with situations which are without precedent and which involve human beings, not merely theoretical problems. It can help the student to see his profession not in terms of applying formulae, but as a continuous filling-in of the unknown. The student experiences life before the full responsibility of it is his and while the college can still interpret and help in the process. There is more to it than periodically thrusting the student out of the academic nest. The usual non-coop graduate is often plunged from the regulated artificial set-up of the classroom, where all effort has been directed toward *him,* into industry where he is of little importance, where he is thoroughly bewildered and often disappointed, a world for which he is often inadequately prepared. There is small value in a college education which is unrelated to life experiences in the process itself. "Knowledge," to quote John Dewey, "is a mode of doing."

The Cooperative Plan cultivates an attitude of mind that makes intellectual pursuit, civic responsibility, and social development natural expectancies. It teaches the student that there is no future in any job but that the future lies in the man who holds the job. It teaches the student that the greatest under-developed territory in the world lies under his hat. It makes him realize that good education is not the art of allowing others to do for him as much as he has the capacity of receiving, but is rather the measure of his own self-preparation. In the final analysis, education is what you have left after you have forgotten most of what you learned.

We are, perhaps, too prone to think of engineering education as education about things. No education is complete without an education about people. Cooperative courses teach students to get along with people and to appreciate the personal problems of various social and economic groups. This is most important as the complexity of our society increases. Cooperative education puts the emphasis on what we *don't* know, as well as on what we *do know.* It promotes a questioning mind along with a close relationship with modern industrial practice. Students hunt for information rather than depend upon someone else to organize it for them. These are qualities which

promote maturity, emotional stability, sound judgment and courage.

The following is a quotation from a concluding paragraph of a work report recently handed in by a student in chemical engineering at Northwestern University after completing an industrial assignment. "There can be little doubt as to whether or not the last period of cooperative work was profitable. In practical experience alone the value is more than can be measured. Then, too, one learns a bit about giving consideration to the other fellow, something we seem to forget in the pressure of our studies. But more than these, there is something gained which lies beyond that immediately apparent—that thing is a purpose. Education is a mockery if we lose sight of the basic things for which it was intended. In my opinion, the cooperative system adds purpose to education."

Promotes Mutual Respect for University and Industry Accomplishment

Dr. Herman Schneider, the originator of the Cooperative Plan at the University of Cincinnati has said, "There is a by-product of the system which defies phrasing—it is a quality that comes from being required to face the day's work squarely and successfully. It comprises the development of a silent strength of will combined with honest judgment rather than capricious criticism. It is a good thing for a man to sweat his way toward the truth." Dean Schneider's concept of education has both increased the respect of the University Campus for practical industry and cultivated among men in industry a new respect for University accomplishment. The Cooperative system is truly the American Way.

In the News

At a special reception at the French Consulate in New York City, the French Legion of Honor was conferred upon Dr. D. B. Steinman, internationally eminent bridge engineer on his birthday and the eve of his sailing for Europe. During his European tour he received many honors, including an honorary degree at Bologna, a gold medal at Rome, receptions and honors at Brussels and Ghent, and culminating with four medals and three decorations at Paris.

To meet "the pressing problems of nuclear engineering and the related sciences," with particular interest in "industrial usefulness," **Engineers Joint Council,** composed of major American engineering societies with a total membership of 170,000, announced initial steps toward an organized program of confronting these problems "authoritatively by a group of leading engineers."

In making the announcement, Thorndike Saville, President of the Council and Dean of Engineering at **New York University,** commented that "action by this powerful engineering group is further evidence that nuclear energy is well on the way to having important peace time industrial usefulness."

The Initiation of Research*

By WALTER C. VOSS

Professor of Building Construction, Emeritus and Lecturer, M.I.T., and Consultant in Architectural Construction and Materials

The old cliche "Necessity is the mother of invention" might be broadly rephrased "Research is the price of survival" in order to set the stage for our discussion of research. Living as we do in an economy and a country where ideas and perseverance are rewarded, we find our lives are surrounded by the activities of persons and groups striving to capitalize on their ideas and to improve their status by an endless array of approaches, some scientific, some commercial and some only so-called hunches, which they hope will provide the solution to their ever present needs for progress. Such activities command the indulgence of those involved in business ventures, educational improvement, advancing the science of health, social welfare and government problems. In each of these fields there is a continuous demand for ideas and methods to provide solutions for the mandatory needs required to maintain or accelerate progress. The urgency of these needs stimulates "trial straws in the wind" to test practicability or forces the decision to study the problem carefully to test the validity of what often are preconceived hypotheses.

These efforts may be said to prompt the initiation of research. Without going into the classic discussion of fundamental and applied research, it can be said that no research in any basic field ever starts without the stimulus of a growing need to remove the penumbras of doubt and the lack of knowledge in that field. Once the need is recognized there follows a period of analysis of related work and the preparation of an initial program. The preparation of the necessary equipment and the conduct of required tests follow. When some semblance of a solution emerges, the newly found ideas are checked by preliminary trials or pilot runs. If these justify the conclusion that the approach is practical and exploitable, the first stage of the research is completed. But this is not the end in the usual case. When the success of the first effort becomes known by any one of many ways, others adopt the springboard of this initial work to solve problems which they may have thought hopeless because of the lack of the newly found facts.

Follow Progressive Pattern

After the initial efforts and perhaps after one or more successive applications of the effort are made, it is very often the case that other investigations related to the original efforts are undertaken which are based wholly upon the desire for pure fundamental knowledge. The whole broad field of research is filled with a great variety of objectives from those based on purely personal or commercial expediency to the purest search for the extension of knowledge where no advance conviction that the facts when determined will have any immediate applicability. All of these follow the same progressive pattern and are a necessary part of a growing, progressive economy in a safe, free world.

How do some of these projects start? A few examples, some of which you will

* Presented at the March 1954 meeting of the Southeast Section of the ECRC.

easily recognize and others which are merely work-a-day occurrences, will illustrate. One very unglamorous and purely commercial initiation of research occurred some years back. For many years laborers slaked quicklime in improvised wooden boxes. The resulting putty was very plastic and satisfactory. Then, an enterprising manufacturer conceived the idea that steel mortar boxes would save time and trouble and soon his sales promotion resulted in the use of the steel boxes by contractors. But something peculiar was happening to the putty when the steel boxes were used. It had lost its plasticity and the manufacturer of the lime was losing most of his customers. Survival dictated that an answer must be found for this unusual situation. His laboratory men and several consultants tackled the problem and after considerable "cut and try" experimentation discovered that the steel box grounded the batch and destroyed its plasticity. Thus, the simple expedient of insulating the steel box from the ground solved an immediate need. This was, however, not the end for the inquiring mind. From the simple necessity inherent in this case have grown a host of research projects involving the influence of potential on the micromerities of lime. Much of this work has been fundamental and applied research projects have continued in this field, and many students in colleges have tackled facets of the same problem. A simple but imperative commercial need initiated the study, the unfolding of the phenomena interested others who saw applications of the same principle to other problems and needs.

Need Amplified By an Idea

With an eye to expanded markets for the products of his plant, a prominent industrialist whose product, celluloid, was gaining increasing applications, conceived the idea that it should be possible to produce a thin, transparent, tough sheet which could revolutionize the packaging industry. He had the packaging of cigarettes in mind. He told his research men that they might have a limited time and unlimited funds but that he wanted this product. The result was cellophane. You are all aware of the growth of this idea which originated from a need for greater sales. Many subsequent studies and experiments, both applied and fundamental, have gradually merged into the many ramifications of the plastics industry as we know it today. It would require many hours to relate the many projects and to assess the tremendous effort and the large expenditures of funds of which this infant industry has been the beneficiary. Nevertheless, most of these originated with a need amplified by an idea.

Many times a desire resting heavily upon the mind of a scholar or technician prompts the initial efforts to seek a solution. Would it not be possible to improve communications, said Morse, as he set about applying the new-found electrical current to a signalling device using a shorthand alphabet. Another scientist explored the possibilities of using mechanisms to fit equations to curves resulting from test data which baffled existing mathematical science or involved laborious effort and time. With the aid of funds from sources appreciating the new avenues which the solution of such mathematical approaches might open, he initiated the researches which after further applications of the idea and methods resulted in our great calculating machines. The desire to photograph fast moving objects resulted in the discovery of stroboscopic light and its correlative necessity, high-speed photography. Such discoveries always aid immeasurably in reassessing some of our older concepts and in improving our approach to the more rational solution of old problems already thought finished. There are too many of such fascinating episodes to do more than call your attention to these few at this time. They all follow a definite pattern. They all illustrate that a great desire or need, coupled with the activities of keen minds and with the exercise of tenacious courage

finally win out. Funds are always available wherever and whenever such ideas suggest the possibilities of application to an industry or to another important problem, the solution of which is momentarily slowed down because of gaps in our knowledge.

Galaxy of Researches

The gradual awakening to the necessity for a solution of many of our social and economic problems has prompted a galaxy of researches. Our business men are concerned with the reasons for certain human behaviors; they want to know how they can cope with organized groups; they wish to fathom the phenomenon of public acceptance to help their sales; and they need a solution to the great problem of expanded markets and higher purchasing power. While many people would not normally think of these projects as research, tremendous sums and untold effort have gone into studies seeking solutions. Again the need and the reward prompt action.

In the medical field the picture is just as thrilling. The desire to save lives and to relieve pain here plays a scientific and emotional role. The reward which comes from success in these endeavors is more than financial—it is soul satisfying. The many discoveries within the last fifty years have stimulated the medical profession and a host of scientific people to apply the newly available equipment and techniques to old problems. Vast sums have been made available in this field by foundations, individuals, public subscription, medical schools and manufacturers.

The saga of the small beginnings which were to be the initial spark to ignite the now important field of atomic fission is well known by now. The first experiments with high voltages by Van de Graf, the succeeding developments of the cyclotron were all prompted by a tacit refusal to believe that the atom was indestructible. Physicists had believed for some time that the nucleus of the atom possessed tremendous pent-up powers. Much of this work was done with funds supplied by sponsors who had faith in the men who dared. The atom was split. Nuclear power was found. But then came the great need; the need for national survival. Man's inhumanity to man demanded that this great discovery be turned into the channels of war. You know the rest; the atomic bomb. Only recently were we admonished to use this newly found power to harness all of the mechanisms which we already had. The development of tracers has changed many of our methods of experimentation in industry and medicine. When this power and the elements of its action finally finds its application in all of our old techniques, many of the hidden recesses of knowledge will stimulate even greater expansions of our ideas of this world of ours.

So much for a very brief and insufficient rehearsal of research, its initiation and corollary impacts producing extensions of research. What is the pattern by which research proceeds? It seems to me that the governing seed of all research is a *need.* This must be followed by the desire on the part of some person or persons to satisfy the need. In the initial stages of any new concept a great deal of "cigar-box" applied research is done. This is, of course, guided by all existing knowledge and techniques of which the researcher is conscious. In many cases any extensions of such studies must have commercial significance. This will provide funds. If the idea is broad enough it will set up a chain of researches which will dwarf the original objective in its importance.

Succession of Steps

It is desirable, I believe, to restate the succession of steps which usually are taken in any project and then to suggest the requirements for its successful consummation. When a need is discovered the first step should be to prepare a clear and a concise statement of the problem and its objectives—State the Problem.

This should be followed by a study of existing knowledge bearing on the problem—Review Existing Knowledge. Then comes the task of setting up the scope of the work to be done and the ends to be attained if possible—State An Hypothesis. Following this comes the experimentation; the ever-liquid approach as new phenomena or conditions appear; the gradual process of testing the hypothesis not only by the originators of the work, but also by colleagues who are interested. The publication of results and of probable conclusions or the success of the recommendations when applied by the sponsor will gradually build up acceptance. In the process many offshoot ideas will usually be developed, which in turn may stimulate other studies in another direction; or, the impassable barriers of the unknown will set the search in motion for more fundamental approaches to remove such barriers.

Research properly and honestly pursued is enervating, expensive and often frustrating. Research demands the proper number and talents of personnel who have faith, courage, and who refuse to be frustrated. It also requires funds in sufficient amount to do a thorough job. I should like to present an abbreviated and annotated statement of the requirements laid down by The Engineering Foundation to determine whether their support would be justified.

A. Title of Research
B. Object of Research
C. Background Information
D. Facilities and Personnel Available
E. Probable Cost of Research
F. Background of Person or Persons Making Request

In closing may I repeat these important words again—"Research is the price of survival."

Sections and Branches

The **Ohio Section** Annual Meeting was held at Ohio State University at Columbus, Ohio on May 1, 1954. R. S. Paffenbarger presided at the Morning Session which included talks by B. L. Stradley and G. B. Carson, both from Ohio State University, and a talk by B. R. Teare, Carnegie Institute of Technology. This was followed by a discussion led by H. E. Fritz on "Opportunity Unlimited." At a business luncheon, the following new officers were elected.

Chairman—K. F. Sibila
Vice Chairmen—E. C. Clark
N. R. Rimboi
Secretary—A. R. Weber.

YET Awards were presented and reports were made on YET activities and the ECPD Training Committee.

The Afternoon Session with G. L. Tuve presiding included talks by G. A. Delaney, General Motors Corporation and W. F. Powell, General Electric Company.

The **Michigan Section** held its Annual Meeting on May 8, 1954 at the University of Michigan.

The Morning Session consisted of individual conferences of six engineering branches.

The Afternoon Session included a Report from Council by W. P. Godfrey, University of Detroit, a Report from the ASEE Secretary, A. B. Bronwell, Northwestern University, and a discussion of Evaluation of Engineering Education with a Panel composed of G. G. Brown, University of Michigan, W. E. Stirton, Wayne University and J. D. Ryder, University of Illinois.

New officers elected at this meeting were:

Chairman—C. C. Sigerfoos
Vice Chairman—G. H. Howell
Secretary-Treasurer—C. Fanning
Rep. on Council—R. H. Schoonover.

How Should We Educate Civil Engineers?

By B. A. WHISLER

Head, Department of Civil Engineering, The Pennsylvania State University

In recent years the leaders in engineering education have been advocating changes in curricula which are now being put into effect in many colleges. These changes reflect the increasing preoccupation of these leaders with the scientific aspects of engineering education and are the result of the emphasis now placed upon research and development in the manufacturing industries. The changes proposed and now being put into effect may be appropriate for the fields of engineering where the graduates go largely to manufacturing industries, but for several reasons they should not be applied to civil engineering.

All engineering is a combination of art and science and is distinguished from the basic sciences by the application of those sciences to the problems of mankind. Since the separation of the other branches of engineering from civil engineering several decades ago, the scientific aspects of the other fields have become predominant while in civil engineering the art of engineering has remained as a very important factor. It is quite usual in the manufacturing industries to make decisions which are based almost exclusively upon exact scientific facts concerning the materials to be used and the results to be obtained. Such a decision is unusual in civil engineering, for rarely can the civil engineer avoid the facts that his materials are extremely variable and therefore very imperfectly understood, and that each of his problems involves the satisfaction of a multitude of conflicting public interests so that almost never does he finally complete a project which he believes to be the best solution from the purely abstract scientific viewpoint.

Employment of Civil Engineering Graduates

In making changes which are the same for all engineering curricula, the very important fact that civil engineering students are being trained for some phase of the construction industry is completely ignored. That civil engineering students do go to the construction industry can be shown by a detailed analysis of the type of employment accepted by civil engineering graduates. The experience of the Pennsylvania State University may be used as an illustration. Questionnaires voluntarily completed by civil engineering seniors at Penn State just before graduation have been analyzed to obtain the pertinent information. This analysis covers the period from February, 1948, through February, 1954, and is based upon replies from 64% of the total number of graduates.

The distribution of graduates based upon the type of employer is shown in Table I. It is apparent that these graduates enter widely divergent types of companies and that no one type predominates. A relatively small number, 8.2%, entered universities as graduate students or teachers, the only real outlet for civil engineers interested in research and development problems. About 1/4 of the graduates entered manufacturing industries.

No exact knowledge of the precise type of work which these men did immediately after graduation, nor what

TABLE I

DISTRIBUTION OF EMPLOYMENT BY TYPE OF EMPLOYER

Classification	%
Consulting engineers	13.5
U. S. Government agencies	9.6
State agencies	11.7
Municipalities	2.5
Public utilities	2.5
Railroads	8.9
Contractors	9.6
Fabrication and erection cos.	9.2
Basic steel manufacturing cos.	3.5
Manufacturing industries	10.6
Aircraft cos.	4.6
Oil cos.	4.9
Self-employed	0.7
Universities	8.2
	100.0

they are now doing, is available. It is possible, however, to classify the type of work in each job on the basis of knowledge of the employment practices of the companies and upon information obtained directly from many graduates after they have spent some time on the job. On this basis, the type of work done by these graduates immediately upon graduation has been classified in seven categories. The distribution in these classes is shown in Table II. It may be seen that nearly half of these students took positions in or directly allied with construction. As the operations and maintenance positions accepted by civil engineers in the manufacturing industries usually involve a considerable amount of construction and may be almost entirely construction, it is not unreasonable to include these positions with construction. This inclusion indicates that 80% of these students became involved with the construction industry to some extent.

TABLE II

DISTRIBUTION OF EMPLOYMENT BY JOB CLASSIFICATION

Classification	%
Construction	12.4
Design	7.1
Design-construction combination	34.7
Operation and maintenance	33.0
Sales	1.4
Geodetic surveying	3.2
Education and graduate studies	8.2
	100.0
Construction and design-const.	47.1
Construction, design-const. and operation	80.1

Another factor which has considerable significance is that civil engineering graduates are not employed in large numbers by single employers. This is indicated in Table III which shows the distribution of graduates by the number employed per employer. Eliminating those going to universities, 259 students were employed by 116 different employers and 1/4 of the students went to employers who have hired only one man from Penn State during these five and one half years. An analysis of the latter group shows that they are predominantly small organizations such as municipalities and consulting engineers or companies so far distant that their employment of Penn State engineers would occur only because of some special situation which would not be apt to recur.

TABLE III

DISTRIBUTION OF EMPLOYMENT BY NUMBER EMPLOYED PER EMPLOYER, NOT INCLUDING EDUCATION

No. Employed per Employer	% in Each Class
1	25.8
2	16.9
3	11.6
4	6.2
5	7.7
6	7.0
8	3.1
9	7.0
10	7.7
18	7.0
	100.0

These employment records indicate that civil engineering graduates are employed by a wide diversity of employers

with no one type predominating, but that nevertheless they are largely employed in some phase of the construction industry. This is not surprising as, almost by definition, civil engineering is the engineering of the construction industry. If civil engineering curricula were to emphasize the preparation of graduates for the fields of research and development, they would be entirely unrealistic.

In other fields of engineering the employer is depended upon to develop in the graduate engineer an understanding of the art of engineering and the applications of the basic scientific principles of engineering through formal or informal training courses. This can be expected because these employers are largely organizations of great size employing large numbers of graduate engineers each year. Smaller companies may obtain their engineers from the pool of young engineers developed by the large organizations. In civil engineering, however, the graduates go predominantly to smaller organizations which employ relatively few engineers each year and do not have the facilities for training programs. Therefore the undergraduate training program must be broader and must include more training in the art of engineering. The graduate civil engineer must be prepared to do a good productive job for his employer immediately upon reporting for work.

Requirements of a Civil Engineering Curriculum

Specifically, the current proposals for changes in engineering curricula take the form of requiring additional courses in higher mathematics and physics and other additions of this nature. Such changes are necessary for students who will later work in fields which require this specific background, but for the civil engineer such courses are of little significance. Because of the type of work he does, there are many other subjects of much more importance to the usual civil engineering graduate.

Upon entering the construction industry civil engineering students very quickly assume a degree of independent responsibility not reached by those in other fields for many years. It is not unusual, for example, for them to be supervising large construction projects a year or two after graduation. This is particularly true if they begin work with some organization, such as a state department of highways, which has been losing its older engineers and has been unable to replace them adequately. Such an organization must of necessity give a high degree of responsibility to its young engineers very early.

As a result of the early responsibility assumed by the young civil engineering graduate, he is soon placed in a position where he must be able to communicate accurately with his supervisor, both orally and in writing. He must be able to report accurately and concisely upon the progress of a job, the need for changes in design, the reason for having made field changes, and many other such matters. In college he should be well grounded in spoken English and more particularly in written English. With the present lack of emphasis on English at the high school level it is more important than ever at the college level. The present trend toward placing a greater and greater emphasis on higher mathematics and physics is requiring more credits for these subjects. This requires a reduction in credit for other courses. There is serious danger that the result will be a decrease in emphasis on the use of the English language.

The civil engineer, whether in the field of design, construction, or maintenance, deals with a much greater variety of materials than does any other engineer. In addition to the metals which are handled by others, he deals with extremely complex, variable, and poorly understood materials such as soils, portland cement concretes, and asphaltic concretes. Hardly an institution in the country covers these materials adequately at the undergrad-

uate level. There was once a time when the coverage was better, but in recent years the study of materials has been neglected in order that new subjects might be added to the curricula; subjects which only rarely would have direct application to the work of the practicing civil engineer.

Similar arguments could be made for the need for a greater study of labor relations, accounting, economics and other subjects. Most civil engineers could profit by such studies and would find them much more useful than the study of differential equations and atomic physics.

Quality of Civil Engineering Graduates

New curricula have been designed to train the engineering student of superior intelligence along lines even more specifically pointed toward research and development than those proposed for engineering curricula in general. The very best students are being recruited for these curricula. For the very superior student who is truly interested in such work as a lifetime occupation, this is an excellent development. There is the danger, however, that the glamour and prestige of such an elite curriculum will attract many who by temperament and interest should remain in a regular engineering curriculum in order to be better prepared to enter into normal engineering activities. Brilliant minds are needed in the traditional engineering jobs as well as in research and development.

It has become commonplace to think that the engineer in the construction industry need be only a person of average intelligence. This is anything but true. The civil engineer is responsible for the conception, design, and execution of the works of the construction industry, the largest industry in the country. In contrast with other fields of engineering where the products last only a few years at most, the civil engineer builds for decades, and in some cases for centuries in the future. The highest type of intelligence is needed for such work. The quality of man needed to supervise the construction of the San Francisco-Oakland Bay Bridge, the Hoover Dam, or the great works of the TVA certainly needs to be as high as for any other field of engineering. Yet few of these men need such advanced training in mathematics and physics as many of our leaders in education would now require. The few civil engineers in advanced design of a very special nature who do need such specialized education can best acquire it at the graduate level.

By the very nature of his work, the civil engineer on the average job is much more independent of others in the conception, design, and execution of his work than are other engineers. Certainly intelligence and broad vision are as necessary in all phases of the everyday construction project such as a new sewage or water treatment plant, a highway relocation, or a flood relief project as in the design of a new manufactured product or a machine for making it. The need for a broad education and a highly intelligent approach to the problem is just as great for the civil engineer concerned with the small project as it is for the civil engineer on the greatest project, and the need for a knowledge of advanced science is even less.

Engineering educators must make a special effort to guide to specialized curricula only those brilliant students who are particularly fitted for them. The highly intelligent students who should remain in the traditional civil engineering field must be shown that tremendous opportunities are awaiting him in civil engineering.

Modernization of Civil Engineering Curricula

One of the standard and often repeated criticisms of engineering curricula is that they have not changed with the times and therefore are completely out of date. This criticism is particularly applied to civil engineering. A superficial examination of the curricula might give credence

to this belief, but to those who study the matter thoroughly, its falseness is obvious. Just because a subject entitled "Reinforced Concrete" appeared in a 1910 curriculum and still appears in present curricula is no evidence whatsoever that the curriculum is not up to date. It merely reflects the fact that reinforced concrete is now and long has been the most important single construction material. The content of such a course as actually taught is the critical point in the determination of whether or not a curriculum is up to date. If the course is taught as it was in 1910 it is obviously out of date, but if the course includes the significant modern developments in theory and practice, as is the usual case, it is as up to date as it would be with a new name.

Surveying, which is virtually the oldest and most universal of civil engineering subjects, has been a part of civil engineering training from the time of the first curriculum to the present day. It reaches back to the beginning of written history, but the continual addition of material concerning new methods and equipment such as photogrammetry and electronic measuring techniques has kept surveying courses completely up to date.

As significant new developments have taken place in the field of civil engineering, some have become sufficiently important to justify inclusion in curricula as separate courses. Improvements in the understanding of the engineering properties of soils and of the phenomena of hydrology have resulted in the inclusion of separate courses on these subjects in many curricula. Such courses include the advanced training in the sciences which is necessary for an understanding of these new developments. For example, an elementary knowledge of statistics is necessary for the proper understanding of hydrological problems. Most schools are continually revising and improving their curricula in this way.

Decision of Major Importance

Educators in the field of civil engineering are faced with a decision of major importance. On one hand we can follow the present trend toward increasing the concentration of undergraduate training in mathematics and physics. Our graduates will become less trained engineers and more trained physicists. On the other hand we can consider the actual engineering work our graduates do and concentrate our efforts upon the improvement of a program of broad training in both technical and non-technical subjects designed to provide a solid foundation for a lifetime of work in civil engineering. In this case we will depend upon graduate study and upon the training of long experience for the development of our specialists. If we believe in a broad basic education at the undergraduate level for civil engineering students of all levels of mental ability, we must speak up now, while we still have the opportunity.

ANNUAL MEETING

June 20-24, 1955

Pennsylvania State University
State College, Pa.

Report of the ASEE Manpower Committee*

Current Demand for Engineering Graduates

By June 3, the Engineering Manpower Commission had tabulated returns from the 1954 Survey of Demand for Engineering Graduates, initiated by the Engineers Joint Council's Special Surveys Committee, covering almost exactly the same number of companies and governmental agencies as in the 1953 survey. These organizations, moreover, had in their employ on January 1, 1953 94% of the same number of engineers as did the 1953 survey sample and, with few exceptions, there was also close correspondence between the coverage for the two years within individual industries and in government. It has been concluded, therefore, that the 1954 data, adjusted for the 6% total difference in coverage as measured by the number of engineering graduates in the employ of these organizations, may be compared directly with the 1953 data in order to determine significant differences in the demand between the two years.

Table I, attached, presents summarized data from these surveys for industry and government combined. In general, industry accounts for about 85% and government for about 15% of the sample. 1952 data from the 1953 survey have been included to bring out the general trend. Current needs have been expressed in terms of the net accessions expected and required by these organizations since that figure is the resultant of the employment of both current and experienced graduates and of returns from military service as related to the losses of graduates from all causes. In the final analysis, such accessions must come from new graduates or graduates entering employment from military service.

In this table, line 5 for 1953 and line 3 for 1954, as adjusted, namely, the number of graduates in the employ of these organizations on January 1, 1953, have been made to match. Proceeding from this base, line 6, 1953, expected net accessions, is comparable to line 4, 1954 adjusted, net accessions realized in the matched sample. Comparison of line 6, 1954 adjusted, with the corresponding figure for 1953, shows a decrease in expected net accessions during the two years of about 21%. Undoubtedly this constitutes recognition of the fact that the graduating class in 1954 had decreased in about that same ratio. Interestingly enough, however, the decrease in required net accessions is also about 21%. In both years expected net accessions are about 60% of those required.

Two general conclusions may be drawn on the basis of these samples. First, the decline in business activity and defense orders in 1954 has led to a decrease in the requirement for engineering graduates of about 20%. Second, with the relatively small classes graduating at this time, despite this decrease, there is still substantial unfilled demand.

Actually, in total employment, these samples covered 8%, plus or minus, of total non-agricultural employment in the country and about 25% of the employed engineering graduates. If any attempt were to be made to estimate the total demand from the samples, the figures shown might be multiplied by four, assuming that current demand would be proportionable to the total number of graduates employed. It is probable, however, that the responding companies

*Presented at the Annual Meeting of ASEE, University of Illinois, June 14, 1954.

TABLE I

DEMAND FOR ENGINEERING GRADUATES

Surveys of Engineers Joint Council Committee

	1953	1954	
		Actual	Adjusted
1. Number of organizations	376	377	—
2. Total employment	4,151,210	3,279,086	3,480,000
3. Total engineering graduates, January 1 previous year	116,653	117,821	125,100
4. Total net accessions*	8,433	6,508	6,900
5. Total graduates, January 1 current year	125,086	124,329	132,000
6. Total net accessions			
Expected*	6,692	5,254	5,560
Required	11,386	8,449	8,950
7. Total graduates, December 31	131,778	129,581	137,560

* Employment from current and earlier classes, plus returns from military leave, minus losses from all causes; slightly adjusted to balance.

have a relatively higher current demand than those who did not do so and this process might result in unduly high estimates. There seems little doubt, however, that actual demand is greater than the current supply.

Supply of Engineering Graduates

Table II presents data concerning the supply of such graduates for the same two years only. The 1953 data here are unchanged from the report of a year ago. Those for 1954 are only slightly altered as the result of new figures for the ROTC. Both tables omit any figures regarding entrants into and graduates from post-graduate work. Since, normally, those numbers might offset one another, there is some evidence that currently the numbers of graduates completing *full-time* graduate work exceed those entering it. If, however, there is any further supply from this source at least an equivalent number of men would be absorbed in education itself.

There are excellent estimates from Dr. Henry Armsby of the U. S. Office of Education concerning the numbers of graduates expected in 1955 (23,000),

TABLE II

SUPPLY OF ENGINEERING GRADUATES, 1953 AND 1954

	1953	1954
1. Graduates	24,000	19,000
2. ROTC commissions	4,500	6,000
3. Draft eligible and other reserves (a)	7,200	7,000
4. Net for industry and civilian government (b)	12,300	6,000
5. Returnees-Recent graduates (c)	14,000	12,000
6. Totals for industry, etc.	26,300	18,000

(a) 1953—Engineering Manpower Commission Survey.
1954—Remainder after deduction of ROTC, veterans, and 4 F.

(b) 1953–Derived directly from Lines 2 and 3; about ⅔ pre-Korea veterans and ⅓ 4 F.
1954—4 F (⅓ of non-ROTC and non-veterans) + veterans (15% of class).

(c) ROTC and draft eligibles 2 years previously.

1956 (30,000) and 1957 (34,000). No attempt has been made, however, to estimate the remaining figures in this table because of uncertainties in military requirements.

General Considerations

In fact, it is apparent that the most important elements in this problem now can hardly be reduced to numbers. Underlying all of them are the critical international situation and the demands it may create through need for a massive build-up in weapons to maintain the balance between the Communist and free nations, or through full-scale war itself. In this connection, we are reminded that Russia is estimated to have graduated 43,000 engineers in 1953 and possibly 60,000 graduates of institutions similar to our technical institutes which had only 11,000 graduates.

More specifically, the Department of Defense has been unwilling to estimate the number of ROTC commissions in the next few years, since it will be dependent on both military forces on active duty and the reserve program now under intensive study. Although draft calls currently are at the low level of 18,000 per month, they are expected to rise to 23,000 during the last six months of 1954. With the expiration, however, of one million enlistments during the next few months and the sharp drop in the reenlistment rate, the increase in Selective Service calls may have to be far greater even if the total military forces are not increased.

From the point of view of the most effective possible use of a country's engineering and scientific manpower, there have been several disturbing elements in the situation:

a. The position of the Director of Selective Service that there should be no exemptions for physically fit young men resulting in numerous withdrawals of occupational deferments and those for graduate students without full recognition of individual qualifications and needs. Occupational deferments, about 40% of which are for engineers, are now below 20,000 and have been decreasing several hundred per month.
b. The present expectation that the training and experience requirements for MOS classification in the scientific and professional personnel group will be raised, resulting in the increased malutilization of engineers and scientists called to active duty.
c. The building up of a huge reserve through the operation of the Universal Military Training and Service Act, subject solely to call by the Department of Defense in the event of war.

Recently there have been definite indications that the administration is coming to realize more fully the nature of this problem. This was manifested in the recommendation of the Appley Committee on Manpower Resources for National Security released in January that both immediate and selectively callable reserves be established, with the former relatively limited in size and with call up of the latter subject to civilian control on a selective basis. In six or seven large industrial states, the Selective Service system has set up advisory committees to assist the Selective Service Boards in considering applications for deferment of professional personnel. More generally, there seems to be increasing recognition that deferment policy must be geared not solely to the present cold war situation but to the necessities which may be imposed by a greater future emergency. It is our conviction that the Engineering and Scientific Manpower Commissions and their staffs have made significant contributions to the development of such a point of view.

D. S. BRIDGMAN,
Chairman, ECAC Manpower Committee

The Technical Institute and Some of Its Problems*

By C. S. JONES

President, Academy of Aeronautics

At the Winter meeting of the Technical Institute Division, one of the speakers, President of a thriving engineering research concern, stated that until he started to assemble the material for his talk about graduates of technical institutes he himself had not realized the number and importance of such graduates employed by his own organization, and he chided us for failing to keep industry informed as to their capabilities.

Dean Freund, in his paper "The Technician and Engineer," presented at the Florida meeting, expressed similar sentiments and closed his remarks with the suggestion that the Technical Institute Division devote its time educating the engineering profession. Consequently, we decided to devote our main effort toward acquainting prospective students, parents, engineers, and employers with our activities. This report is in line with this policy.

To implement such a policy it seems wise to review what has been done, to explain the improvements we have been attempting to make, to analyze the reasons why there has been so much lack of information, or even mis-information, and why it has been so difficult for the Technical Institute to put over their story.

The Technical Institutes have a long and honorable history. Mechanics Institute was founded in 1785 in New York, and several other institutions are over 100 years old. True, these early schools were intended to upgrade and provide technical instruction to supplement the apprentice training largely prevalent at that time. It was not until 1931 when the Spahr Wickenden Report was published that much attention was given in higher educational circles to such institutions. This report, which proved conclusively that approximately three trained technicians or semi-professionals should be employed for every engineer, was widely read and discussed, though no immediate action was taken.

Starting at the turn of the century a series of highly technical inventions changed the industrial, commercial and military habits of the nation. Gas and diesel engines, the airplane, radio, television, electronics and others made sweeping changes, requiring the services of a new kind of personnel; the modern technician. Many of these inventions would have developed much more slowly if it had not been for their adaptation to military use, and the fact that in this period we engaged in two world wars, where money and brains were made available in unlimited quantities to perfect them.

Take the airplane. The Army ordered its first plane in 1908, and by 1914 had a total of only fourteen planes, a handful of pilots and there were only two aircraft companies. By 1944, only 30 years later, the aircraft industry produced 20 billion dollars worth of aircraft and became the largest business the world has ever known. In 1914 the airplane

* Presented at the Annual Meeting of ASEE, University of Illinois, June 14, 1954.

was a simple mechanism with ordinary gasoline engine, stick and wire construction, almost no instruments, which any ordinary mechanic could keep in operating condition. Contrast this with the modern aircraft with its myriad of instruments, pressurized cabins, electrically controlled propellors, retractible landing gears and hundreds of highly technical gadgets and you realize that the ordinary mechanic will no longer do. It takes a highly skilled, highly trained technician with tremendous know how. Or take a little thing like the modern bombsight that electro-mechanical brain which almost instantly computes speed, drift, windage, and altitude to the target, and just prior to the release of the bomb, actually flys the aircraft over its target. It is easy to understand why such an instrument needs an expert to keep it in operation, and not even a trained engineer could do it without technical know how. And so, in all branches of the service—the horse has been replaced by the tank and jeep, the gun fire on battleships is done electronically, even the typewriter is electrically operated. With the outbreak of World War II when much of this mechanization had been perfected thousands of men were needed to keep the equipment running and so the military enlisted support of the schools, first the technical institute (we started our program in 1938) and later colleges and universities.

Mutual Respect Established

I well remember when the representatives of six large Eastern Colleges and universities sat in my office, sent there by the Air Force, to learn how we, a lowly technical school, trained technicians so capable in such a short time. The Department of Education in the states of New Jersey and New York, who in the early days took a dim view of our activities, actually took over our institutions during the war which we rented back and operated for them in order that we, a proprietory school, could utilize government funds for the necessary training program, and I can safely say that this close contact and understanding did much to establish a mutual respect which still exists. This entire military program did much to strengthen our own curricula and in many colleges gave the engineers an insight into the technical training program.

Thus in 1944, when the Engineers' council for Professional Development appointed a sub-committee with Dean H. P. Hammond of Penn State as Chairman, there was not much resistance to setting up the accrediting system for technical institutes which is now in force and which last year approved curricula in 26 such institutes. I have always felt that the appointment of Dean Hammond was a stroke of genius and extremely fortunate for our schools, for here was a man widely respected in his field, who had made a true analysis of the situation, appreciated the value of the technical institute training, and had the courage and initiative to act. At the American Society for Engineering Education meeting in Austin I had breakfast with him and started to thank him for what I considered his effective efforts in our behalf. He quickly stopped me explaining that he was not doing it because he particularly liked the technical institutes or wanted to help them. Rather he felt he was helping the colleges. He said that the facilities of the engineering colleges were overcrowded, that they could not turn out the needed number of engineering graduates, that many men in these colleges were incapable of becoming professional engineers and were consequently wasting time and facilities and probably should be in a technical institute. He finally stated that he figured an engineer who did not utilize the services of technicians to relieve him of a lot of detailed work that the technician could do just as well, or better, was not doing an efficient job, and probably should not be an engineer anyway. If more of the engineering fraternity had this philoso-

phy and breadth of viewpoint we would not still be arguing as to whether or not our graduates could properly be called "engineering technicians" and that an "Associate Degree" is the proper award for our graduates.

Shortly after the establishment of this accrediting system, the Technical Institute Division of the American Society for Engineering Education was formed and during the last six or seven years has grown into a healthy and aggressive branch of the organization.

At about the same time a group of proprietory schools organized a National Council of Technical Schools, adopted a code of ethics, thus adding another stabilizing influence. Spurred on by these organizations the schools themselves have made great strides in improving and strengthening their curricula, their faculty and their facilities. While the minimum accredited curriculum is 960 contact hours over a period of one academic year, most of these schools offer courses far in excess of this. It must be remembered that most technical institutes operate six to eight hours per day, five days per week over a 44 to 48 week year, with few vacations. Entrance requirements have been raised and only bona-fide high school graduates are admitted. Most institutes now require an applicant to pass well conceived entrance tests and have found that this policy has paid real dividends. Courses in advanced mathematics, physics, chemistry and the like are now common practice and are certainly at the level of higher education. Because of the great amount of technical work covered in a relatively short time, the teaching of English and the Humanities has been neglected, but even in these fields an effort is being made to include a reasonable amount of instruction. Many institutions have embarked in sizable research programs, and placement and counselling have greatly improved.

While I am on this subject I would like to say that we are far from happy at the preparation of the average high school graduate in such basic subjects as English, Mathematics, Reading and Spelling. I wonder if it would not be a worthwhile project of the American Society for Engineering Education to encourage the high schools to strengthen these subjects, even at the expense of the highly controversial extra curriculum activities, so when a boy enters our institutions we won't have to waste so much time teaching him the things he should have learned in high school.

Functions of the Modern Technical Institute

So much for what has been accomplished. Before discussing some of our problems I would like to include for the record a brief summary of the actual functions of the modern technical institute, even though I suspect they are well known to most of you. The technical institute fills the gap between high school and college. Its curricula are of a technological nature and lie in the post-high school area. They differ in content and purpose from those of the vocational schools on one hand and from those of the engineering college on the other. Their purpose is to prepare individuals for various technical positions in the field of engineering, but more limited in scope than required of the person preparing for a degree as professional engineer. The engineer plans—the technician makes and does. The engineer creates the project—the technician operates. Programs of instruction are briefer and more technical in content than professional curricula though they are both concerned with the same general fields of Industry and Engineering.

Courses accredited by the Engineers' Council for Professional Development include aeronautics, air conditioning, refrigeration, building construction, diesel and steam engines, drafting and design, electronics, industrial chemistry, machine design, photographic technology, radio and television. The following chart indicates the number of enrollees and the

ENROLLMENTS IN TECHNICAL INSTITUTES—10TH ANNUAL SURVEY

Compiled by Dr. Leo Smith, *Rochester Institute of Technology*

Type of Institution	No. of Schools	Enrollment 1953–1954			Enrollment 1952–1953		
		Day	Evening and Part Time	Total	Day	Evening and Part Time	Total
Federal					—	1,670	1,670
State and Municipal	20	10,192	7,195	18,107	9,239	8,902	18,141
Privately Endowed	11	2,780	7,798	10,578	2,506	8,983	11,489
Ext. Div. of College and Universities	11	2,993	9,774	12,767	2,045	10,885	12,930
Proprietory	19	5,800	3,421	9,221	5,038	3,119	8,157
YMCA Schools	2	51	504	555	12	338	350
Total	63	21,816	29,412	51,228	18,840	33,897	52,737

different types of ownership and operation.

Though these figures are impressive and represent a steady growth, they are a far cry from the suggested 3 to 1 ratio when compared with the 160,000 enrolled in engineering colleges. Several hundred thousand would be more in line.

What then has held up this obviously important branch of education and what are the prospects for the future. Probably the biggest deterrent has been the attitude of the professional engineer in many cases unintentional. Frequently, he has considered the technical institute as a trade or vocational school—in many cases a sort of a racket trying to sell an artesian as an engineer. When as in the '30's there was an excess of engineers it is understandable why he should resent any incroachment in his field and why trained engineers had to do work below their true capabilities. The engineering employment manager, himself often a graduate engineer, was guided by the same thinking so it was difficult for the technical institute to get a hearing and for its graduates to get a job commensurate with his ability and training.

In the early days of our own school I spent over half my time begging my friends in the aircraft industry to use our graduates—placing one here and one there—largely on a friendship basis. And then I remember the day when the Chief Engineer of one of our big companies 'phoned to say he would hire our entire graduating design class, largely because engineers were getting short in supply and he had to have somebody. And then I think of the hundreds of our graduates hired by this same company since that time and the general acceptance of them by the aircraft industry, no longer because they cannot get anyone else, but because they do the job. And the contrast today when some months before graduation representatives of industry come to our door to interview our students, many of these representatives being our own graduates an astute bit of salesmanship when competition is as great as it is and when each graduate has an offer of several positions.

Enginering Graduate and Technician Supplement Each Other

And so this road block is being gradually broken down, but we will not reach our goal until engineers in general come to the same conclusion that Dean Hammond did years ago, namely, that there is a place for both the engineering graduate and the technician, that they supple-

ment each other and that their effective joint effort as a team is essential.

When this happens the situation will take care of itself and we can see signs of progress. States, counties and municipalities are establishing technical institutes as evidenced by the present ambitious program in New York State. Community and Junior Colleges are turning more to technical curricula. The military still maintains a vast system of technological education.

In spite of these encouraging signs, we still have a long way to go if we are to meet the 3–1 ratio of technicians to engineers suggested by the Spahr Wickenden report, mentioned earlier. This report is over 20 years old, and should be brought up to date, or a new one made. It is believed this is of sufficient importance to justify a grant from one of the foundations.

Figures from abroad indicate the United States is lagging in technological training. England has twice the numbers, while figures from Russia report several hundred thousands in technical schools.

From the military viewpoint the great advantage of the United States over its potential enemies is its engineering genius, technical know how, and production ability. The fact that we enjoy a far higher standard of living than any other nation is largely attributable to the same reasons. If we are to maintain this superiority, either in war or peace, a sound, coordinated and expanding system of engineering and technical education is a prime necessity.

Sections and Branches

The **National Capital Area Section** of the American Society for Engineering Education held its Annual Meeting 8 May 1954 at McMahon Hall of The Catholic University of America.

Mr. Henry H. Armsby, section member on the General Council, made a complete report of the Council's activities and submitted a written copy to the Secretary for the section's files.

Vice-Chairman Michalowicz then introduced Messrs. R. H. Buescher and E. K. Von Fange, both of the General Electric Company's Creative Engineering Program. Mr. Von Fange spoke on "Creativeness in an Engineering Program." This was followed by a "brainstorm" session which obtained about fifty ideas to bring Creativity into an engineering education in specific courses by the audience. A provocative and stimulating discussion followed. It was recommended that other sections have meetings like this one.

Professor John L. Artley, chairman of the section's committee on Young Engineering Teachers, presided at the afternoon session. He introduced the winners of the YET paper contest for the section: First Place: Robert M. Adams; Second Place: a tie between A. Lawrence Guess and Haaren A. Miklofsky. Chairman Walther congratulated the winners and presented them with certificates and cash prizes from the section. Professor Adams read his paper entitled "Value Concepts of Engineering Education."

With Chairman Walther presiding at the final business session, the Resolutions Committee presented its report. Finally the Nominations Committee (L. K. Downing, Chairman; L. E. Otts, Jr.; H. P. Gallogly, D. E. Howard, R. Goetzenberger) presented their slate which was unanimously accepted. The new officers for 1954–55 are:

Chairman—J. C. Michalowicz
Vice-Chairman—R. H. Roy
Secretary-Treasurer—D. E. Howard
Representative on General Council—
H. H. Armsby.

THE T-SQUARE PAGE

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Building Blocks of Engineering Education

By A. S. LEVENS

Professor, Division of Engineering Design, University of California

A summary of a preliminary report by the ASEE Committee was presented in the November 1953 issue of the JOURNAL OF ENGINEERING EDUCATION. This summary points out the increasing importance of the basic sciences in engineering progress. As examples of the increased importance the committee cites developments in electronics; problems related to structures; research in heat transfer; fluid mechanics; jet and rocket propulsion; metallurgy; etc.

The committee stresses the importance of the basic sciences—mathematics, physics, and chemistry—in engineering curricula. It suggests that mathematics through ordinary differential equations seems close to a minimum essential for all engineers. It recommends greater emphasis upon basic science in engineering education. The committee recognizes nine important background sciences in engineering. These are statics; dynamics; strength of materials; fluid flow; thermodynamics; electrical circuits; fields and electronics; heat transfer; engineering materials; and physical metallurgy. The committee believes "that all of these studies should be represented in curricula that train engineers for service in research, development or design, and that probably seven should be integrated into every curriculum that is represented as education for engineers."

Many engineering educators would agree with the committee's view of the importance of the basic sciences and the recognition of the "background" sciences in engineering. Personally, I do not quarrel with what has been included but am quite disturbed over the omission of a very important field—graphics. Should not the study of graphics be represented in all engineering curricula? In my opinion our engineering students will not be adequately prepared to meet the technological challenges of today nor of the future without (a) thorough knowledge and use of the fundamentals of projection; (b) reasonably proficiency in graphical representation—working drawings, pictorial sketches, etc.; (c) knowledge and use of graphical calculus, introductory phases of nomography, and graphical methods of computation.

Important Role

Graphics has played and continues to play a very important role in industrial progress. It is an essential part of the engineers preparation. We must continue to strengthen our students in engineering by providing them with many opportunities to make fuller use of mathematics, physics, chemistry and graphics. Our students should become aware of the fact that nearly all solutions of engineering

problems are at best close approximations; that judicious use of various methods may be advantageous. In some cases the mathematical tool is best, in others the graphical tool, in still others a combination of the two methods is indicated, and in certain instances a combination of graphical, mathematical, numerical, and mechanical methods is best suited to the analysis and solution of phases of an engineering problem. Certainly it would be considered poor engineering to insist upon a mathematical solution when, for example, a simpler graphical solution is available. We have become, by training, accustomed to the use of algebraic methods in solving problems, and we have developed a "reverence" for the reliability of answers that are obtained by such methods. Many students believe that "correct" answers to problems obtained by the manipulation of equations are exact. This may be true for "ideal" problems. Often problems are concerned with time, temperature, pressure, length, etc., quantities that can be measured only approximately. The reading of a thermometer, for example, can only be as accurate as, among other things, the graduated scale (graphical) and the visual acuity of the observer. This is also true of lengths, whose measurement again depends upon a graphical scale; or of pressure, whose measurements depend upon a gage mechanism and a scale for reading numbers; or of voltages, currents, and many other quantities which are measured by devices that indicate values on a scale which is read by an individual. The *data are graphical* in nature. Certainly many problems that inherently are based on graphical data can be solved by graphical methods with sufficient accuracy. The fact that we use numbers, obtained by reading various scales, in a mathematical solution of the problem, does not by any stretch of the imagination, make such a solution more accurate than a graphical solution.

We know that thorough training in mathematics is essential to sound engineering and scientific training. It is, however, important for students not to get a warped view; for their training to lead to the intelligent use of several methods, and, it is hoped, to the development of good judgment in the choice of methods. Surely the economical aspects have a decided bearing upon the choice of the methods employed.

Our engineering curricula must also provide time for adequate preparation in the field of graphics—a field which is definitely at the college level—not for the training of draftsmen *per se* but rather for the development of engineering students who are preparing for the engineering profession.

Suggestions for Adequate Training

The present day need and future needs for well-prepared engineers—men who can cope with problems that will arise in new fields, men who thoroughly understand basic principles, men who are capable of a high degree of "imagineering"—is so vital that our position as leaders both in a free society and in technology may well be at stake. Good training in graphics can contribute significantly to the development of the engineer of the future. To provide for such training, I offer a few suggestions:

1. We should continue to do a good job in the basic graphics courses, but let us not hesitate to revitalize course content. We should not include such trivia as pencil sharpening, lettering, simple geometric constructions, etc. These skills should be prerequisite to a college level course. Granted that some engineering schools do not require high school drawing for admission, it is certainly in order to require the student to take a noncredit course which will provide for training in the above-mentioned skills. We can and should carefully review course content with a view toward strengthening the student's grasp of basic principles, and yet not sacrifice the goal of attaining proficiency in technique. We can pay more attention to the use of freehand sketching

and the use of time-saving methods by eliminating needless repetition of duplicate details. By making judicious use of freehand sketching, the elimination of non-essentials and the simplification of delineation, actual drawing time may be reduced considerably. Such time-saving measures coupled with pre-engineering drawing preparation would permit us to introduce elementary phases of advanced graphics —graphical calculus, nomography, and graphical methods of computation—*in our basic courses.*

2. We should participate in research projects. Here may be found excellent opportunities to demonstrate the effective use of graphical methods. As a result, classwork can be enlivened by citing cases where graphics proved invaluable.

3. We should make every effort to work closely with our colleagues who teach other courses, such as mathematics, mechanics, strength of materials, design, etc. We can correlate graphics training with the work in these fields. This is very important in order to provide for continuous use of graphics throughout the engineering program.

4. Some schools should offer advanced graphics courses—at the senior and graduate level. The fields of nomography and graphical computations, including the solution of differential equations, afford many opportunities for advanced work.

5. We should initiate or assist both in the formulation and implementation of graphics courses that would contribute considerably to the preparation of high school mathematics and science teachers. This is quite important if we are to prepare a new group of engineering students who will come to us with some appreciation of graphical methods and their importance both in engineering and science.

The implementation of the above suggestions means that we must encourage bright young instructors to carry such programs forward. It is incumbent upon us to make every effort to motivate the interests and arouse the enthusiasm of such young men for active participation in the fascinating field of graphics. Instructors in fields other than graphics should be invited to participate in the teaching of graphics so that the carry-over into other fields will be more efficient.

We shall have to share our progress and work together much more closely than we have in the past if we are to continue to grow and keep pace with the current and future needs in engineering education.

Sections and Branches

The **Middle Atlantic Section** of the ASEE held its Spring Meeting, May 8, 1954, at Lafayette College, Easton, Pennsylvania.

The General Morning Session was addressed by Dr. A. C. Monteith, Vice-President in charge of engineering at Westinghouse Electric Corporation. The topic of his talk was "Professional Development—A Mutual Responsibility."

After a short business meeting and luncheon, the afternoon sessions were started. The program consisted of five group meetings with the following topics: (a) Orientation and Training of Engineers by Industry; (b) Teaching Thermodynamics to Engineers; (c) Improving Students' Report Writing; (d) Should Mathematics and Physics be Taught as a Combined Course; (e) Professional Development of the Young Engineer.

Teaching Tips

Thwarting the Two-Day Term Report

By J. D. THOMAS

Associate Professor, Dept. of English, The Rice Institute

The only justification for a term report in the English (or, presumably, any other) department is that it is the outward evidence of an educationally useful process that really does require an extended period for collection of material, for organization of thought, and for composition and revision. When the paper is huddled together by a student in the last week of the term, no one profits. Either the student is trying to delude the instructor—and perhaps himself as well—by offering a few frantic hours as the work proper to a term project; or he is stealing time from all his other courses during the critical pre-examination period. Each of these alternatives is educationally vicious, and they are not even mutually exclusive! We all know the refrain: "I'm sorry, but I just can't do . . . , because I have to write my term paper for Professor . . ."

Student behavior being a corollary of general human nature, there is just one way to prevent the two-day term report, and that is to make certain that a due proportion of every week of the assigned period actually is spent on preparation of the paper. The rule must be inflexible: only one week's work may be performed in any week. Allow a single deviation from this pattern, and you will be confronted with a half-dozen valid excuses from every dozen students. It is amazing how few grandfathers have funerals when it is known that the nature of an excuse makes no difference, in the sense that only the work of a single week may be done during the following week. In rare cases of extended illness and the like (they really are rare among people of college age), the instructor naturally will use his judgment as to how much the partial report is worth, but he still must permit only one week's work for each active week; after all, apart from any other considerations, that is only fair to the student and to his other instructors.

I present the following directions exactly as I distribute them to my students in a course offered primarily for sophomore science and engineering majors. Although in the first instance they were designed for the purpose indicated by the title of this note, I wish to point out that they obviate another great difficulty with term reports. If a student hands in a paper that is "all wrong," possibly not even on an assigned topic, there is not much that can be done about it at the end of the term, as criticism at that time practically is wasted. But if week by week every stage of the paper is reviewed by the instructor (each part is of course promptly returned, with marginal notes), it is impossible for students to go completely astray except by willful refusal to heed criticisms. I should like to point out, also, that the distribution of time indicated below allows a reasonably long period for the gathering of material and for outlining. Every instructor knows by experience that the average student thinks he can begin writing a long report almost before he has chosen a subject, and that this kind of haste is a prime cause of academic waste.

Colleagues are heartily welcome to copy

r adapt these directions in any way that may be serviceable in local situations.

Instructions for Long Paper

The purpose of this project is to help you learn a good method of preparing, writing, and documenting an investigative paper over an extended period. Preserve this sheet, and note on it the instructor's specific assignment of topic and any special directions given in class from time to time.

You should understand from the outset, and bear in mind at all times, that the PROCESS of investigation, planning, and composition is the whole point of the assignments, and that you will be judged by your success in following the specified sequence.

If *for any reason* you can not (or do not) perform the assignment of a given week, that assignment is automatically deferred to the following week and all subsequent assignments are likewise deferred one week. (It is not fair to you or the instructor to allow several weeks' work to be performed and submitted in one week, and it is also not fair to your other courses to permit the work of English 220 to cumulate.) Since only eleven weeks are available for the ten weekly assignments, the result of falling behind two weeks or longer would be that one or more of the important final assignments would never be written. If, however, you have a legitimate excuse for getting more than one week behind schedule, you may submit a full explanation in business-letter form. The instructor will take such statements into account, along with the work actually performed, in determining your grade for the course.

Assignments are due at the beginning of the class hour on Thursday of each week. In case of valid excuse (not mere whim), they will be taken as late papers on Friday or Saturday of the same week (*except* during Dead Week). The reason for the lateness of any paper submitted on Friday or Saturday instead of Thursday must be noted below the endorsement.

Be sure you understand that: (1) *under no circumstances will two assignments be accepted in one calendar week;* (2) *no assignments may be skipped;* (3) *nothing will be received during Dead Week.*

SCHEDULE

Week 1 —Submission of (at least) two possible topics.

Week 2 —Final choice of topic, with statement of the problem and tentative plan of attack.

Week 3 —Tentative bibliography in form explained and illustrated in textbook; OR account of personal interviews.

Week 4 —Thesis sentence.

Week 5 —Thesis sentence (revised as necessary) plus main topics (only) of sentence outline.

Week 6 —Full sentence outline.

Week 7—Sample section ending about 500 words *beyond* first footnote), with footnotes in form explained and illustrated in textbook.

Week 8 —Remainder of first half of paper, with footnotes (in form indicated for Week 7).

Week 9 —Second half of paper, with footnotes (in form indicated for Week 7).

Week 10—Outline (revised as necessary), complete paper (with corrections), and full bibliography (in form explained and illustrated in textbook).

IMPORTANT NOTE: If properly carried out, each of the ten assignments requires about the same amount of work. Week 4, for example, though in form only one sentence, represents the hardest and most important act of analysis of the entire series of assignments. If you dash off a sentence without long preparation and serious thought, you will later find that you are trying to construct a building on a crumbling foundation. DO A WEEK'S WORK EACH WEEK.

Engineering Graduate Placement Test Research

By A. PEMBERTON JOHNSON
Project Director, Educational Testing Service

On April 26, 1954, representatives of five leading employers of engineering college graduates met with representatives of ETS's Personality Research Division to make detailed plans for a cooperative industry-sponsored research program aimed at the development of placement tests for engineering college graduates. This research is an outgrowth of inquiries made to ETS about three years ago by the Committee on Student Selection and Guidance of the American Society for Engineering Education. A research plan has been developed with the assistance and encouragement of their Committee and of the Relations with Industry Division of the American Society for Enginering Education.

The cooperating employers are: The Bell System, The Detroit Edison Company, the B. F. Goodrich Company, the IBM Corporation, and the Westinghouse Electric Corporation. Dr. David R. Saunders of ETS is director of this research project.

It is anticipated that within several years the placement tests, developed through this research, may supplement the experience and judgment of skilled interviewers and become adjuncts to improved engineering manpower utilization, by aiding in the early placement of each newly-hired graduate in an area of work *through* which he might reach his maximum potential for the company and for himself. Examples of some important areas of work which may be studied are: applied research; design; development; day-to-day engineering operations like production, construction, or utility operations; and technical sales. The marked economic and social advantages to employers, individual graduates, and the nation at large from improvement in the utilization of each year's engineering graduates are clear.

Plans for the research involve: (1) careful determination and description of the work functions carried out by key-groups of five to seven year experienced engineers who are employed in important areas of work in each of the participating companies; (2) the development and tryout of appropriate tests designed to reflect, to the greatest possible extent, differences in intellectual and personal qualities between successful engineers in the key-groups; (3) the development from the research findings of tests especially promising for use with newly-hired engineering graduates. As early as seems practicable, testing of newly-hired engineering graduates will begin also, utilizing, to the maximum extent possible, findings of the research with experienced engineers. Testing of new-hires will be carefully integrated with the research on five to seven year experienced engineers so that the results of research can be put into practice very soon after they become available. The testing of engineering seniors for selection purposes, which was originally proposed several years ago, will not be done. If mutually satisfactory arrangements with the deans of certain engineering schools can later be worked out, the experimental testing of some engineering senior classes may take place.

EJC and the Engineering Profession*

By T. A. MARSHALL, JR.

Administrative Assistant ASME, Formerly Secretary of EJC

The unity of the engineering profession is a topic of great interest to engineers. In the belief that the Engineers Joint Council can become the unity organization that the profession is seeking, the author shows how the Council is organized, and discusses what it is doing now and how it is developing.

Unity has several meanings. It is subject to different interpretations by different individuals. Unity can mean, for example, "absence of diversity." It can mean "uniformity"; or "a unity of sentiment"; or "unification." It can mean "continuity without deviation of change." These are some of the accepted definitions of unity.

Such unity is not the kind that the engineering profession wants, or needs, or means, or can achieve when engineers speak of unity. In dealing with this problem, as in dealing with any other problem, there must be fundamental agreement regarding its basic elements.

There would seem to be two essential elements of engineering unity. First, the unity organization must be formed, not to achieve unity in the afore-mentioned senses, but to achieve unity in the sense of solidarity. Solidarity connotes a community of interests, objectives, standards, and responsibilities that will permit the profession, as a group, to express its opinions, manifest its strength, or exert its influence as a unit in specific areas. This does not require "uniformity" or "absence of diversity" or "unification," or "continuity without deviation or change."

An excellent example may be found in the American Medical Association (AMA). This organization frequently is alluded to in discussions on engineering unity. Many doctors disagree with some of the policies and actions of AMA. Some doctors are not even members of AMA. However, the association does express the opinion of the medical profession as a group without the unanimity expressed in some of the definitions of unity previously mentioned.

Second, there must be—and this may be considered by some as heresy—a recognition, expressed in the purposes and actions of the unity or solidarity organization, of the value of self-interest, individual and organizational, as a motivating force toward successful and continuing operation. A unity organization cannot be formed or maintained without the support of engineers; their continued support cannot be obtained unless the unity organization includes, among its primary aims, aiding the engineer to improve himself and improving the professional climate for engineering.

Within the engineering profession there already are a number and a variety of organizations; unity organizations, at least in one sense. Engineers concerned with one broad area of engineering, such as civil, mechanical, electrical, etc., have formed societies to work together in de-

* This is a condensation of an article on EJC, its purpose and objectives, reprinted from *Electrical Engineering*, May, 1954.

veloping and promoting an interchange of ideas within those basic areas. Such societies have served, for years, as a core for their members within the technical areas of their competence. They have developed standards and codes for operation and safety that have become recognized and used by many outside of the profession. They have become national authorities and spokesmen within the technical areas of their competence. It must be remembered, however, that their primary reason for existence is to help their individual members develop themselves. This is a prerequisite to all other activities. Similarly, there are local or regional societies or councils that serve the common interests of engineers residing in a community or region.

Some effort must be directed toward self-development of engineers in order to create an organization that will enable engineers as a group to serve mankind without selfishness. When this is done, it will permit the individual members of the profession, and the profession as a whole, to make their greatest possible contribution to the national welfare. This, in turn, will create a climate in which the individual engineer can function more effectively as a recognized professional person.

The AMA and the American Bar Association are virile unity organizations within their professions primarily because they aid doctors and lawyers to develop themselves professionally. True, their contributions to the national welfare are notable, but those organizations are supported because they aid doctors and lawyers to develop themselves.

Areas of Unity

Next, consider the areas in which an effective unity organization in the engineering profession might operate to achieve these goals. There are problems arising from time to time within the profession that are generally national in scope and in importance that the existing societies individually are not equipped, nor in a position, to handle. Many of these problems are nontechnical but require a coordinated degree of technical competence in several fields.

These problems fall into two broad categories. First, those that affect the individual engineer only indirectly, and in much the same manner as they affect any individual citizen. These might be called national welfare or public service problems. Second, those that affect the individual engineer much more directly. These might be called professional problems.

Public Service Activities. In the first category are problems on which a small group of highly competent members of the engineering profession perform a much-needed service to the nation on behalf of the profession. These problems and their solutions are most important. They are being handled now, and have been handled for many, many years. The history of accomplishments in this area is impressive. It can be found in the annals of the Engineering Council of the National Technical Societies in America, founded in 1917, and its heir, The American Engineering Council, formed in 1920. At the current time, this is one of the major areas of the activities of Engineers Joint Council (EJC).

The importance of such activities has been recognized by many prominent engineers. The Honorable Herbert Hoover, first president of The American Engineering Council of the Federated American Engineering Societies, commented succinctly on this in his address to the first meeting of the American Engineering Council on November 19, 1920. (1). Mr. Hoover discusses the "foundation of individualism" upon which American civilization has been built. He goes on to discuss the growth and consolidation of voluntary associations within the economic system and the striving of such associations—employers, farmers, merchants, labor—"by political agitation, propaganda, and other measures to advance group interest."

Mr. Hoover goes on to state: "The Federated American Engineering Societies stands somewhat apart among these great economic groups in that it has no special economic interest for its members. Its only interest in the creation of a great national association is public service, to give voice to the thought of engineers in these questions."

Some examples of these national welfare activities, or service activities, are The American Engineering Council's study on "Waste in Industry" or its survey of commercial aviation in 1925. The latter study resulted in the establishment in the U. S. Department of Commerce of the Bureau of Aviation, the forerunner of the present Civil Aeronautics Authority and Civil Aeronautics Administration.

Current examples are the contributions of EJC to the development of a sound national water policy as reflected in their report, "Principles of a Sound National Water Policy"; or the contributions of EJC through its National Engineers Committee on the Industrial Disarmament of Japan, or in the statement of EJC's Atomic Energy Panel to the Joint Congressional Committee on Atomic Energy, recommending changes in the Atomic Energy Act to permit the engineering profession to make its maximum contribution in the development of atomic energy for peaceful purposes.

Professional Activities. Most members of the profession see and understand the necessity for these national welfare or public service activities. Many of them, however, find these insufficient as a rallying point for their own enthusiasm. They will not underwrite a unity organization devoted solely or primarily to such activities. Unless such an organization pursues activities that will help individual engineers to develop themselves professionally, they, in turn, will not give their support or provide the grass roots backing through the technical societies so necessary for the continuity of any successful unity organization to serve both engineers and the nation. Therefore, for this reason, if for no other, there must be concern for problems in the professional area, the solutions to which can be felt by the individual engineer.

In this area, for example, may be considered the problems of the development of the engineer in his profession. This is done through such activities as the accrediting of engineering curricula, the development of standards of ethics, the development of adequate minimum registration requirements, progress toward uniformity of registration, and the like.

Also in this area are studies that have to do with the relations of the engineer with his employer, and the related studies of engineering income, supply, and demand, as well as the problems of monitoring national or area-wide legislation from the standpoint of improving or preventing damage to the climate for the practice of the profession of engineering.

. . . . .

The now-classic report of EJC, "The Engineering Profession in Transition," published in 1946, is another example of a professional area activity. The activities of the EJC Engineering Manpower Commission and the National Society of Professional Engineers (NSPE) in their efforts to improve the utilization of engineers, and their continuing efforts to provide comprehensive and basic information of value to employers of engineers and to engineers themselves in the resolution of their mutual problems relating to working conditions, also might be considered. Another example can be found in the activities of the EJC Labor Legislation Panel. This panel was most successful in having the current professional provisions written into the Labor Management Relations Act of 1947, the Taft-Hartley Act. They have continued their efforts to have these provisions retained in any consideration involving amendment of the Act.

Still a further example can be found in the joint efforts of EJC and NSPE in successfully having the engineer employee practicing his profession exempted

from the provisions of the Salary Stabilization Act.

Public Relations. Related to both of these, professional activities and national welfare activities, is the necessity for an over-all public relations program. A successful public relations program will be a partial solution, at least, of the problem of recognition of the engineer by those outside of the profession.

While the problem of recognition needs a considerable amount of effort behind it, there is progress being made in this area too. Through the efforts of EJC and its committees there has been a rapidly growing appreciation of the engineering profession in the Congress. The activities of the EJC Engineering Manpower Commission in its participation in planning for national mobilization have served to underscore the important contribution of engineers to the national economy, and the necessity for forthright action in connection with the mobilization of specialized personnel. They have been successful in arousing an awareness and understanding of this, not only in the Congress, but also within the Department of Defense, and in other executive branches of the government.

Previous Unity Efforts

What can be learned from the history of previous attempts to establish a unity organization? The most notable previous unity effort on the part of the engineering profession was The American Engineering Council (AEC) of the Federated American Engineering Societies. The AEC was established in 1920 for the betterment of the profession by opening up opportunities for engineering services in and out of the government. It functioned through a council and an executive committee. The Council was composed of representatives of member societies on the basis of one representative for each 1000 members. Membership in AEC ranged from a low of 19 societies, 7 national, 5 state, and 28 local societies in 1932, to a high of 54, 8 national, 18 state, and 7 local societies in 1940, the year in which it was dissolved.

The executive committee or administrative board, as it was called later, was composed of 30 members. Actually it was an unwieldy organization from the standpoint of executive action inasmuch as a two-thirds affirmative vote was required in all decisions affecting policy or action.

Financial support came from assessments of member organizations. Although its membership was national, regional, and local, financial support came primarily from three national engineering societies: The American Society of Mechanical Engineers (ASME), the American Institute of Electrical Engineers (AIEE), and after 1929, the American Society of Civil Engineers (ASCE). Annual contributions from these three organizations accounted at times for as much as 95 per cent of AEC income, and never amounted to less than 75 per cent.

The major objects of the AEC were: "to further the public welfare wherever technical and engineering knowledge and experience were involved" and "to consider and act upon matters of common concern to the engineering and allied technical profession." During the nearly 20 years of its existence, the AEC made many worth-while contributions to the national welfare through its research activities, and through its services to legislators.

A brief history of The American Engineering Council was prepared by A. F. Bochenek in 1951 after an exhaustive study of the old records of AEC. Mr. Bochenek, a member of the editorial staff of ASME at the time, says in his introduction, "Among those who were active in AEC affairs, there seems to be no unanimity of opinion why the AEC, after the signal achievements of the 1920's, failed to sustain the high level of interest in unity among member engineering societies that was so evident when it was

launched during the postwar days of World War I."

In addition to what appears to be one of the major reasons for the AEC's failure, organizational (and financial) defects, there is another possible answer, imbalance of program. To quote further from Mr. Bochenek, in a section covering AEC's services to the engineering profession he says, "While the AEC did serve individual engineers who asked for aid and information, most engineers regarded it as a remote organization working in an indirect and intangible way for the betterment of their profession."

When one considers the success enjoyed by ECPD in comparison, one notes immediately the concentration of its programs on problems and activities in the professional area. To repeat, ECPD is the recognized agency for the accrediting of engineering curricula. ECPD has developed a widely accepted "Canons of Ethics for Engineers" dealing with the relations of the individual engineer with the public, with other engineers, and with his client or employer. ECPD has spearheaded a program in cooperation with industry and the colleges, to aid the young graduate to develop himself technically and professionally during the 5 years immediately following his baccalaureate degree. ECPD, through its Guidance Committee, has done much to bring the story of the engineering profession to students in the secondary schools and to their parents and teachers. ECPD has developed and is spearheading the acceptance of uniform grades of membership in the technological societies. These activities are appreciated, if not endorsed, by individual engineers.

In summary then, two things can be learned about unity from the failure of the AEC. First, an organization must be planned so that the views of the members of the profession will be considered thoroughly in developing policies within which the unity organization will act. The organization must provide for effective executive action in line with those policies, but without the necessity of continual referral back to the constituent members or affiliates.

In providing a channel of communications through which the views of the members of the profession will be considered, the organization must be so tempered that it will not be subject to violent fluctuations of opinion. This is somewhat similar to the problems faced by the founding fathers of the country in developing its method of government. They designed the policy-making segment of the government to reflect the will of the people through their representatives in the Congress. But this takes time. The Congress is not readily sensitive to rapid changes. It takes time for the will of the people to be reflected in Congressional action. The executive branch of the government has the power to act within the framework of laws (or policy) established by the Congress.

Impatience often is expressed at the apparently inordinate amount of time it takes in the development of laws by the Congress. Time, however, is a great means of tempering. Most people, at times, have been impatient in their own business relations. Most have been tempted to act immediately on some problem, and later have been thankful that they took no action on the spur of the moment.

The second thing to be learned from the failure of the AEC is even more important, the effect of imbalance of program. The efforts of AEC were concentrated primarily on national welfare activities.

Its services to members of the engineering profession were confined largely to two major activities. AEC maintained a roster of more than 115,000 names and records that served as a fountainhead of information about engineers conveniently accessable to government departments and commercial interests seeking the services of competent engineers. They were instrumental, in 1935, in encouraging the Bureau of Labor Statistics to conduct a

comprehensive survey that provided, for the first time, reliable information on engineering salaries on a profession-wide basis. As Mr. Bochenek stated, however, most engineers regarded AEC as a remote organization. Thus the grass roots support, and grass roots demand for its continuance, did not exist.

Engineers Joint Council

Why and How It Came Into Being. The EJC was organized formally in 1941 as the Engineers Joint Conference. The Conference grew out of a liaison relationship that had existed between the secretaries of the four Founder Societies for many years.

Actually, the Conference was an outgrowth of the Engineering Council of the National Technical Societies of America formed by the Founder Societies (ASCE, American Institute of Mining and Metallurgical Engineers, ASME, AIEE) in 1917. The 1917 Council was formed to work with the government or engineering problems involved in developing the automobile, the tank, and the airplane into major weapons of national defense. When the AEC was formed, the 1917 Engineering Council discontinued its operations and turned over to the AEC its records, its funds, and its Washington office and staff. The liaison relationship between the secretaries that was engendered by this World War I organization was continued.

Early in the mobilization immediately preceding America's entrance into World War II, the Founder Societies received a number of requests from various governmental activities for information and aid in areas of interest to the profession. It was decided that a more formal organization was needed and the Engineers Joint Conference was established in 1941 composed of the presidents and secretaries of the participating societies. The American Institute of Chemical Engineers became the fifth participating member in 1942.

As the scope of activities expanded, the functions of this organization became of greater significance than that implied by "Conference." The name was changed to Engineers Joint Council in September 1945. Representation of the constituent societies on the Council was increased and a formal constitution adopted.

Expansion of EJC. In 1949, EJC, through its Committee on Increased Unity, sponsored a meeting to discuss the development of increased unity within the engineering profession. Out of this meeting, an Exploratory Group containing representation from ten other national societies in addition to the five EJC societies was formed. During more than 2 years of study, the Exploratory Group developed a program and plan acceptable to most of its members that was submitted to EJC in January 1952.

After some discussion in EJC, its constitution was modified so that the first step in developing the unity organization in accordance with the recommendations of the Exploratory Group could be taken. The first modification of the EJC constitution changed the requirements for membership to permit the extension of invitations to additional societies to join EJC and, at the same time, provided proportional representation from its members.

The change in constitution was ratified by the five constituent societies of EJC by December 7, 1952, and on December 31, 1952, invitations were extended to eight additional societies to join EJC. Acceptances were received from three: American Water Association, The Society of Naval Architects and Marine Engineers, and American Society for Engineering Education, bringing the membership of EJC to eight constituent national societies.

Three of the eight societies invited to join EJC, American Association of Engineers, American Society of Heating and Ventilating Engineers, and the Institute of Aeronautical Sciences, took no action

on the invitations extended and they expired on December 31, 1953.

Two of the eight societies rejected the invitation to join EJC. In its letter of rejection, the Institute of Radio Engineers (IRE) requested continued cooperative activity with EJC on specific problems of mutual interest. Their rejection was dictated by two basic policies of long standing. First, that IRE shall not engage directly or indirectly in legislative activity. Second, that IRE as a society is not entitled to represent its members as individual members of the engineering profession, or, as a body, on social or general professional matters, and shall not, as a society, take a stand even on technical matters.

After considerable study, and additional meetings between a special joint committee consisting of three members of EJC and three representatives of NSPE, the latter organization declined to accept the invitation to join EJC. In the resolution adopted by the board of directors of NSPE on November 7, 1953, the invitation was declined "at this time, in accordance with the firm conviction of this Board that no organization can adequately represent the engineers of this nation, unless that organization is based primarily on individual membership and constituted to assure prompt and effective means of communication between the individuals, their local or state units, and their national governing body." The resolution goes on to express the firm desire of NSPE to continue mutual efforts toward the most effective action possible between the two organizations.

While NSPE did not accept at this time, the study resulting from the joint committee did much to further a mutual understanding between the two organizations. In addition, it has provided a very valuable document for the guidance of EJC. The Joint Committee on Relations Between EJC and NSPE is being continued by both organizations further to explore areas of mutual cooperation between the two societies.

Organization and Objects of EJC. The present Council itself its composed of 19 representatives of the eight constituent societies in proportion to their membership. Representatives and alternates on the Council must be members of the governing boards of the societies they represent. The presidents of the constituent societies are members ex-officio of the Council. The president and vice-president of EJC and the members of the Executive Committee are elected from among the representatives at the Annual Organizational Meeting to serve for one year. The EJC constitution provides that the president, the vice-president, and the other members of the Executive Committee each must be from a different society.

The objects of EJC as expressed in its constitution are as follows:

1. To advance the general welfare of mankind through the available resources and the creative ability of the engineering profession.
2. To promote cooperation among the various branches of the engineering profession.
3. To advance the science and the profession of engineering.
4. To develop sound public policies respecting national and international affairs wherein the engineering profession can be helpful through the services of the members of the engineering profession.

There is ample recognition here of the necessity to provide a balanced program. EJC actually carries on activities in both the national welfare or public service area and also in the professional area.

Public Service Activities. EJC's activities and the work of its committees fall into both of the broad areas previously mentioned, national welfare or public service activities, and professional activities.

In the first category, its Committee on Engineering Sciences cooperates with the National Science Foundation in initiating

and developing basic research in the engineering sciences. That committee also assists members representing engineering on the National Science Foundation Board. It has a task committee working actively with the National Science Foundation on the development of the engineering section of the National Scientific Register.

The EJC Committee on International Relations acts as a coordinating agency between the profession in the United States and abroad. The committee has been working actively with the Pan American Federation of Engineering Societies (more familiarly known as UPADI from the Spanish title, Union Panamericana de Asociaciones de Ingenieros). EJC is the United States member of UPADI. The Committee on International Relations was instrumental in helping to rebuild the engineering libraries of war-torn countries by acting as a clearinghouse for contributions of books that were delivered through the medium of the United States Book Exchange.

EJC also has an Advisory Committee to the Lewis Historical Publications, the official publishers of "Who's Who in Engineering." There is representation, not only from the eight constituent societies of EJC, but also from the Institute of Aeronautical Sciences, Engineering Institute of Canada, the IRE, Society of Automotive Engineers, and NSPE.

In addition to its work on the industrial disarmament of Japan, EJC's National Engineers Committee has continued to function in an advisory capacity to government agencies such as the Federal Civil Defense Administration, and the President in connection with the establishment of the St. Lawrence River Joint Board of Engineers.

Professional Area Activities of EJC. In the area of professional development, EJC is continuing, through its Special Surveys Committee, its surveys of supply, demand, and professional income. NSPE is represented on that committee also. A study of "Professional Income of Engineers in 1953," covering the income of nearly 70,000 engineers employed in industry, education, and government, recently was released.

The Engineering Manpower Commission of EJC has been working actively for the past 3 years to secure the most effective use of engineers in the national health, safety, and interest. In this area, it has done much to stimulate the interest of qualified high-school graduates in careers in engineering. It also has done much to promote more effective utilization of engineers, not only by the government, but also by industry.

Of major significance in the professional area, however, is the work of two committees. First, the Committee on Employment Conditions, through the constituent societies, has been making a study of employment conditions for engineers. While its work is not yet complete, that committee is studying the interest of engineers in collective bargaining, in professionalism, and in other activities which affect their employment conditions.

Second is the Committee on Recognition of Specialties in Engineering. As a result of a suggestion that came to EJC through the Joint Committee on the Advancement of Sanitary Engineering, a committee was formed to consider the problem of recognition of specialties in engineering. This need was emphasized by the difficulties encountered by sanitary engineers in being recognized as competent within their specialty, especially by those outside of the engineering profession. Sanitary engineers work very closely with members of the Public Health Service, and with the medical profession.

After the EJC Committee on Recognition of Specialties was established, the problem was discussed with the Joint Committee on the Advancement of Sanitary Engineering, and the EJC committee is watching with a great deal of interest the work being done by the joint committee in developing plans and pro-

cedures for recognition of sanitary engineering as a specialty.

Current thinking is along the lines of specialty boards to examine candidates in a somewhat similar manner to that employed in the medical profession. When the plans and procedures have been worked out in full detail and have been tested in the pilot study on sanitary engineering, they unquestionably will be extended to other fields cutting across the interests of more than one of the constituent societies. Hydraulics and nuclear engineering are two examples.

Other EJC Activities. EJC is in the process of changing. It is entirely different now than it was 2 years ago. As its activities progress, and as the Council studies and implements the recommendations of the Exploratory Group, it will continue to change. It can become the unity or solidarity organization for the profession.

In this connection, there are two most important activities. One of the recommendations of the Exploratory Group concerned the affiliation of state, regional, and local societies with EJC. A special committee now is working actively on that problem. That same committee also is studying the affiliation of national societies that meet all the requirements for EJC membership except that of size.

The second activity of interest is the matter of individual participation in EJC. This is deemed to be of such importance that the Executive Committee itself is devoting additional time to the problem.

It is hoped that the individual members will follow news of EJC and submit their suggestions for improvements, especially improvements that will help build EJC into the organization which engineers want and need.

Conclusions

If, in its activities, EJC gains the support of the individual members of the engineering profession, it can become the unity organization that engineers have been looking for. In order to be successful, however, it must have the interest and support of the individual engineer.

However, those who desire a collective bargaining agency as a unity organization will have to look elsewhere. EJC cannot and will not become a collective bargaining agency, nor will the existing technological societies.

To those who point to the strength of unity organizations in the medical and legal professions, remember that both of those professions are predominantly self-employed. There is no collective bargaining problem there. To attain public recognition and true professional status, especially in the eyes of the public, initiative, resourcefulness, creativity, and individual incentive must be encouraged among the members of the professions. These will be the tools through which engineers can be developed professionally, the practice of engineering improved, and the profession can provide effective services to the national welfare, or in the public interest. These factors are the direct opposite of collective bargaining.

Engineers as professional people have an obligation to devote a share of their time, efforts, and funds as a service to the nation in matters affecting the national welfare or in the public interest. If they do not carry on such activities, they will not maintain a professional status.

Activities of the type carried on by EJC are mandatory. It is of tremendous significance that only a year after AEC ceased its operations, engineers were forced to form another organization, EJC, to fill this need or concede that the engineering profession as a whole was voiceless in matters of national concern. Since 1917, there has been, except for 1 year, an organization engaged in such activities.

A successful and continuing unity or solidarity organization to serve the engineering profession can be built upon the framework already established in EJC

and the developments it is undergoing, if engineers will lend it their constructive support. Unless EJC is built into the spokesman for the profession in these areas of activity, engineers will find themselves represented by other, less-qualified, organizations hardly distinguishable from labor unions. What engineers, as individuals, get from EJC, or from any other organization for that matter, will be in direct proportion to what engineers as individuals put into it.

REFERENCE

(1) "Some Phases of Relationship of Engineering Societies to Public Service," Herbert Hoover. *Mechanical Engineering*, New York, N. Y., vol. 42, December 1920, p. 722.

Lamme Award

The Committee on Lamme Award is always anxious to get nominations for the Award from the membership of the Society. Any member may place a name in nomination; the selection will be made by the Committee by letter ballot.

The Lamme Award consists of a gold medal and bronze replica bestowed annually upon a distinguished engineering educator for excellence in teaching and contributions to the art of teaching; contributions to research and technical literature; achievements which contribute to the advancement of the profession; and engineering administration. The Lamme Trust Fund was established in memory of Benjamin Garver Lamme. For a brochure describing the Award and a nomination form, please write to the Secretary, Professor A. B. Bronwell, Northwestern University, Evanston, Illinois.

Nominations should be sent to the Chairman of the Committee, Dean F. E. Terman, College of Engineering, Stanford University, Stanford, California by February 1, 1955.

The George Westinghouse Award

The George Westinghouse Award is an annual award established in 1946 by the Westinghouse Educational Foundation to recognize and encourage outstanding achievement in the teaching of students of engineering. The Award consists of $1,000, together with an engraved certificate.

The Award has been established to encourage younger men who have shown, by their past record, evidence of continuing activity as superior teachers. To them the Award may serve not only as a reward but as an incentive toward further achievement.

In order to achieve this intent, it is deemed essential to limit the Award to those who have not reached the age of 45 by the date of the annual presentation.

Nominations may be made by any person, organization, or group and are to be submitted before February 1, 1955 to the Chairman of the Committee on Award, Professor F. H. Pumphrey, University of Florida, Gainesville, Florida. Nominations must be made on forms available from either the Chairman of the Committee or from the Secretary of the Society. Nominations should be accompanied by significant evidence supporting statement and claims.

A Suggested Research Policy for the Guidance of Engineering Schools

Adopted by ECRC, June 1954

By ERIC A. WALKER

Dean of Engineering, Pennsylvania State University

The following statement of Research Policy was adopted by the ECRC at the Annual Meeting of the ASEE, June 1954.

Introduction

The primary functions of a university are generally recognized as (1) instruction, (2) advancement of knowledge and (3) public service. In an engineering school these three functions may be integrated to the advantage of students and faculty, the advancement of the art and science of engineering, and the welfare of the nation. In many academic institutions, the trend in research policies is towards research primarily motivated by scientific curiosity. Engineering, however, is by its very nature the application of art and science; hence it is essential in engineering to include applied research and development.

Role of the Professional Engineer

The professional engineer is a practitioner who depends upon Art and Science in the utilization of materials and natural forces in the creation of desired structures, products, processes or devices. Knowledge of the physical sciences and of the engineering sciences forms important background for predictions of the performance of components and systems, but engineering design is also an art requiring sound judgment, practical experience, creativeness, and intuition. The engineer needs an absorbing interest in the problems which must be solved and a sense of responsibility for solving them satisfactorily. He usually must reach his conclusions regarding an adequate design within a limited time and without full information, frequently unable to wait for all the refinements of data necessary for a completely scientific solution. Cost factors must also be considered, and the sound engineering solution is often a compromise between what is technically desirable and what is economically feasible.

Engineering Instruction

In meeting the obligation to prepare students to practice engineering, engineering schools have properly given their first attention to the scientific basis for engineering practice, the conventional four-year program being composed predominantly of courses in the physical and engineering sciences. This emphasis is appropriate because these subjects form a backbone of knowledge necessary for engineers and because they are well suited to formal instruction, but this emphasis should not obscure the fact that engineering schools exist to educate engineers, not scientists. Integration and application of this scientific knowledge to problems characteristic of the various branches of engineering occupies an essential part of the curriculum; in fact, without courses which introduce the student to the practice of engineering and some actual practice itself which is gained from independent work, particularly in the preparation of theses for advanced degrees, there would be little reason to organize separate engineering schools.

Competence in professional engineering requires practice. Engineering faculties must therefore in some way practice engineering, if they are to inspire and guide

students toward professional practice, by posing novel and challenging problems of increasing difficulty and current significance.

Advancement of Knowledge

The engineering school's responsibility for the function of the advancement of knowledge cannot be fulfilled by concentrating solely on research devoted to the discovery of scientific facts and data which will be useful to engineers, important though that research is. The advancement of knowledge in the field of engineering also encompasses improvements in the art and practice of engineering itself. The development of new processes, the evolution of new methods of design and construction, the formulation of techniques for a better balancing of complex factors such as cost, reliability, performance, and ease of maintenance will constitute significant advances in knowledge for engineers.

Public Service

Engineering is a profession. As in the case for all of the professions, engineers have an obligation to public service. It is appropriate, therefore, that engineering schools undertake programs of research or development on the basis of public service which may not contribute as significantly to instruction or the advancement of knowledge as other programs of research.

Policy Summary

Under these circumstances, it is to be expected that the research program of an engineering school should properly embrace the following types of activities:

a. Research to discover basic or fundamental scientific principles and facts which will advance the science of engineering.
b. Applied research or development of specific devices or processes which will develop the competence of teacher and student, thereby serving the engineer in a manner parallel to the clinical studies of the physician.
c. Activities which serve the public interest, as for national defense, public health, or general industrial and agricultural progress.

ECPD Annual Meeting

October 28–29, 1954 Hotel Alms, Cincinnati, Ohio

The subject of the meeting will be "The First Five Years of Professional Development." This pertains to the education and training of young engineers in industry. The Annual Dinner on October 29 will have as dinner speaker James H. Taylor, Assistant Director for Manpower, Office of Defense Mobilization. The title of his address will be "The National Manpower Outlook from the Point of View of the Profession." The dinner and conferences are open to all engineers who are interested in attending.

For information and reservations write to Professor Cornelius Wandmacher, Civil Engineering Department, University of Cincinnati, Cincinnati, Ohio.

American Society for Engineering Education

Report of the Vice President in Charge of Instructional Committees and Divisions For the Year 1953–54

During the past year Committees and Divisions of the Society have been unusually active in many aspects of engineering education, stimulated in large measure by the thought provoking issues growing out of the work of the Committee on Evaluation. The vigorous and penetrating discussion that resulted from the Preliminary Report of this Committee among institutional groups on campuses throughout the country has had a notable effect upon the activities of specific Committees and Divisions of the Society, encouraging them to cooperate in an overall effort to strengthen and improve the processes of engineering education.

The Humanistic-Social and English Divisions of the Society during the year completed arrangements for a research project into the cultural stem of engineering curricula, and the Society has obtained a grant of $30,000 from the Carnegie Corporation to finance the study. Dr. Edwin S. Burdell, President of Cooper Union, has generously agreed to serve as Chairman of the Society's Committee on the Humanistic-Social Research Project, and Dr. George Gullette has been given leave of absence from North Carolina State College in order to serve as the Project Director. Organization for carrying on the study and some visits to engineering schools in which the humanistic-social program has been developed effectively were arranged during the spring of 1954. It is planned that the field work will be completed in the fall and winter of 1954 with the expectation that a preliminary report can be submitted at the Penn State Annual Meeting of A.S.E.E. in June, 1955. The study will be concerned not only with the discovery and discussion of distinctive programs in the humanities and social sciences currently in operation among undergraduate engineering curricula, but also with recommendations as to promising ways in which the humanistic-social stem can be made to contribute most effectively to the education of prospective professional engineers.

The Society's Committee on Graduate Study is making plans to conduct a comprehensive study of graduate engineering education and during the current year has been working with the Executive Board in an effort to obtain appropriate financing for the project. The need for this study of graduate curricula has been pointed out in the Interim Report of the Committee on Evaluation of Engineering Education. There is reason to hope for adequate support of this important undertaking and to expect that it can be initiated in 1954–55.

In the summer of 1954 the Society will operate the largest number of summer schools that it has ever conducted in any one year. These are as follows:

1) An Evaluation of Analytical Techniques of Engineering Economy June 12 and 13, 1954, at the University of Illinois, sponsored by the Committee on Engineering Economy
2) The Elements of Design of Digital Control Circuits

June 18–20, 1954, at the University of Illinois, sponsored by the Division of Electrical Engineering

3) The Development of Creative Thinking in Engineering
August 30 to September 4, 1954, at the General Electric Company, Schenectady, New York, sponsored jointly by the General Electric Company and the Division of Educational Methods

4) Workshop for the Humanistic-Social Study Project
June 18–20, 1954, at the University of Illinois, sponsored by the Humanistic-Social Division

5) The Evaluation of the Engineering Significance of Graduate Training in Mechanics
June 11 and 12, 1954, at the University of Illinois, sponsored by the Division of Engineering Mechanics

6) The Teaching of Machine Design and Manufacturing Processes
June 18–25, 1954, at the University of Illinois, sponsored by the Division of Mechanical Engineering

In addition to these summer schools the Society also sponsored jointly with the Instrument Society of America a Symposium on Instrumentation Education at the University of Illinois on June 12, 1954.

Due largely to the vision and creative effort of Professor Bronwell, the Society has also given leadership to two important Summer Institutes in 1954. One of these, in the field of Solid State Physics in Engineering Education, is comprised of a preliminary conference of leading physicists and engineers at the University of Illinois in the spring of 1954, followed by an open conference at Carnegie Institute of Technology, June 21–25, 1954. The latter is open to engineering physics teachers.

The second Summer Institute, concerned with Nuclear Science in Engineering Education, began with a closed conference at Columbia University and is to be followed by an open conference available to A.S.E.E. members at Northwestern University, September 7–11, 1954. The purpose of these two programs is to consider the treatment of these important aspects of science in engineering curricula.

Noting the increasing interest in summer school activities, the Executive Board of the Society at its Rolla, Missouri, meeting in April, 1954, voted to establish in next year's budget an item of from $1000 to $2000 for the purpose of stimulating significant projects of this kind by making possible the underwriting of unanticipated deficits arising from such undertakings. The Board is of the opinion that summer schools should be planned as self-supporting enterprises but believes that a reserve fund is needed in order to provide for contingencies that cannot be foreseen. Without such a reserve for Committee and Division activities some eminently worth while projects may never be initiated because the sponsors are hesitant to take the financial risk involved.

Particular mention should be made of the splendid service rendered in 1953–54 by the Committee on Young Engineering Teachers under the leadership of Professor Howe of the University of Cincinnati. Not only has this Committee made its influence felt constructively on campuses throughout the country and in the Sections of the Society, but also the group conducted an eminently successful membership drive which brought in many new young engineering teachers to A.S.E.E.

Hearty thanks and appreciation are due to the officers of Committees and Divisions of the Society who cooperated so helpfully in arranging programs for the Annual Meeting. Almost without exception work began in the formulation of committee and division programs in the summer or fall of 1953, and the results of this early start are reflected in the excellence of the program finally arranged for the Annual Meeting at the University of Illinois. Many of the of-

ficers of Committees and Divisions took advantage of the fall meeting of A.S.E.E. and E.C.P.D. in New York to have preliminary round table conferences concerning committee work. Grateful acknowledgment should be made of the fine service so generously given by the editors of the periodic bulletins issued by various instructional sub-divisions of the Society during the year. These publications have been uniformly attractive in format and serviceable in content, bringing to special constituencies much valuable subject matter that otherwise would have been unavailable to them.

I wish to express my personal thanks also to members of the Committee on the Annual Meeting which worked with me in considering over-all plans. The schedule of activities for 1954 at the University of Illinois is generally similar to that of a year ago, but a substantial number of joint meetings have been arranged and every effort has been made to avoid conflicts. The opening session on Monday afternoon for reports of important activities of the Society, which was initiated at the University of Florida, has been continued this year since it appears to serve a useful function.

In conclusion, I want to express my sincere appreciation to all of the Chairmen of Committees and Divisions of the Society whose friendly cooperation has made my tenure of office both stimulating and enjoyable.

Respectfully submitted,

W. C. WHITE, *Vice President*

June 14, 1954

Annual Report of Vice President in Charge of Sections and Branches June 11, 1954

In this, my first year of work with Sections and Branches, I have become well acquainted with many of their worthwhile activities, and I have come to have a high respect for this very substantial base upon which the Society is built.

It has seemed to me that the Society as a whole suffers to some extent from a multifold expansion in many different, separate directions. We have the Engineering College Administrative Council and the Engineering College Research Council to deal with problems of our institutional members; we have divisions, one kind of which are associated with curriculum majors, such as Chemical, Civil, Electrical, Mechanical Engineering, and so on, and divisions of another kind which cut across major fields, such as English, Graduate Study, Educational Methods, Relations with Industry, and so forth. Then we have standing committees and ad hoc committees. All these kinds of subdivisions of our Society are in addition to Sections and Branches.

These kinds of subdivisions are desirable in themselves, but I think they, as well as the Society as a whole, can be strengthened by developing cross-ties, at least of certain kinds. Consider, for example, the Sections and Divisions. Divisions are organized around subjects, programs, and ideas; Sections are based on geography and membership. Divisions are active and productive of good program material, sometimes extending over years of development, yet they have no tangible, definite membership apart

from a small core of officers, directors, and perhaps an advisory committee. On the other hand, Sections have a definite membership—every one of our approximately 7,000 members belongs to some one section, yet programming is an ad hoc yearly task only indirectly related to the other activities of ASEE as a whole.

The section programs are excellent, as I know from first-hand observation. Even so, I think there would be a gain to the Society as a whole if we could achieve a tie between Sections (and Branches) on the one hand and Divisions (at least the kind that cut across fields and the similar kinds of committees) on the other. That is, a section might invite a division to help put on part of its annual program. The section chooses and works with the division according to its current interests. Such cooperation fosters section participation in the development of division ideas by presentation and discussion and strengthens both. The section is kept in a main current of Society activity; the division reaches more members and has more frequent opportunity to meet, although the section meeting may be restricted geographically. The section gets help with its programs. I believe this cooperation will lead to the better and more thorough development of educational ideas and their greater dissemination. I think the present over-all effectiveness of the Society can be criticized on the basis that there is a little talk about many basically good ideas, but the work on them is not carried very far toward the realization of full usefulness, and then the same ideas are brought up again and again without reference to previous discussion. A concerted drive in any period of a year or two might yield a firmer progress.

I have brought this suggestion to many of the sections, and there has been some indication from them of a willingness to try such cooperation next year. It is only fair to say, however, that the response has not been one of unanimous agreement. Of the divisions Relations with Industry has agreed to promote actively such cooperation and integration from its side.

Another kind of cooperation that has been and is being urged is with our associate industrial members, which now number more than 100. The same benefits that such members bring to national activities can be brought to sections if industry members are welcomed as participants in Section and Branch activities.

The Sections and Branches have had a healthy, vigorous year. In the fall the national officers planned their representation at all but the most distant section meetings and with only a few exceptions the plan was carried out. It appears that insofar as is possible it is desirable for the president of the Society to attend the Section meetings.

Respectfully submitted,

B. R. TEARE, JR.,
Vice President in Charge of Sections and Branches

The Annual Report of the Chairman of the Engineering College Research Council, June, 1954

The theme around which all of the work of the Engineering College Research Council has been centered during this past year is that of the creativeness of the engineer. To start off, a one-day conference was held in conjunction with the Engineers' Council for Professional Development in October, 1953. This conference consisted of three sessions; the first was one in which a noted artist, a well known composer, and an author and critic were asked to discuss creativeness in their own professions and, if possible, to analyze the creative process used in reproducing one of their own works. The second session was one in which a psychologist analyzed the creative process and attempted to point out some of the media by which creativeness could be stimulated. The third and last session was one which focused on creativeness in engineering as seen and analyzed by two well known industrial research scientists.

This meeting was an outstanding success, and it is regrettable in some ways that the publicity on it was not more widespread and that more people could not have heard the talks. However, it must be remembered that the meeting itself was of an experimental nature. Also, it is not customary for the Engineering College Research Council to hold a meeting in the fall.

There have been many demands for a printed brochure containing the talks. However, it must be realized that the talks, which were given on an informal conversational plane, are not readily adapted for printing. We have, for the past nine months, been trying to collect or prepare acceptable transcripts of the talks from the magnetic tape recording which was made on the occasion of the presentation of the addresses. In this we have received splendid, but sometimes reluctant, cooperation from the authors. At present we have all but one talk in hand, and as soon as that is available, a booklet will be printed containing not only the talks but also short biographical sketches of the authors. It is our belief that there will be many requests for this publication, since the session opened a new avenue of investigation for those who would try to stimulate creativeness in engineering.

Most of the work of the Council has been done through its committees. First should be mentioned a very hard-working group—the Committee on Relations with the Federal Government, which has functioned for another year under the able Chairmanship of Raymond Woodrow of Princeton University. This Committee, which meets often and which often offers counsel to federal agencies, has done a great deal to keep undesirable phrases and paragraphs out of the research contracts written between universities and the Federal Government. It has fought a vigorous fight to assure that the Government, in contracting for research, pays the proper share of its cost.

The Committee on Relations with Industrial Research Agencies is now entering a new phase. Whereas in the past the policy of the Committee was only to attempt to maintain the existing good relationships between industry and the Engineering College Research Council,

the present Committee is exploring the possibilities of seeking financial aid on a broad scale for research in the universities. There are, up to the present, no outstanding results of this effort, and this is to be expected since all negotiations are in the educational and exploratory stage only. However, it is believed that efforts in this direction will be continued by the Committee under the Chairmanship of Professor S. T. Carpenter of Swarthmore College. Dr. H. K. Work has served during the past year as the Chairman of the Program Committee, and as such he has lifted the heavy load from the shoulders of the Chairman of the Council. In so doing he has had an opportunity to become thoroughly familiar with all aspects of the Council's work, and therefore, it is very fitting and indeed the Council is extremely fortunate in having Dr. Work take over the Chairmanship for the next biennium.

For the past two years Professor Virgil Neilly of The Pennsylvania State University has served as Secretary of the Council. Anyone who is acquainted with the workings of the central offices of this or of any other group must realize that the Secretaryship of the Engineering College Research Council is not a position to be taken lightly. It has proven to be an extremely heavy load and one which requires a great deal of training, followed by a considerable amount of exploratory work and negotiation. It is my firm belief that the position as Secretary is not one in which the incumbent should be changed often, and certainly the change should not be made simultaneously with the changing of Chairmen. On the other hand, there's a great deal to be gained by having the Chairman and the Secretary on the same campus so that they can discuss things often and informally. It is, therefore, with a great deal of regret that I must announce that our present Secretary, Virgil E. Neilly, feels that the demands of this office are too heavy and that he must relinquish the Secretaryship as soon as the new officers can properly provide for the vacancy.

The Chairman himself has found this past two years very stimulating and rewarding. In addition to assuming the general guidance of the Council, the position has provided an opportunity to express the Council's wishes in many directions. The Chairman of the Council is, almost as a matter of course, a member of the Engineering Division of the National Research Council, which enables him to keep in touch with research administrators throughout the country. The Chairman of the Council also has opportunities to speak for the Council in matters concerning the Department of Defense, the Atomic Energy Commission, and the Congress of the United States.

In pursuing these matters, the present Council Chairman has taken a vigorous stand before the Joint Committee on Atomic Energy of the Senate and the House, pointing out that the colleges of engineering of the United States must be allowed to get into atomic research if they are to support and conduct a vigorous and up-to-date educational program, preparing people for careers in the general field of atomic energy. The Chairman has also voiced his opinion that the patent system, which has been long established and has proved its worth, must also be allowed to cover atomic energy matters, as well as other discoveries and inventions. Discussions have been held with members of the staff of the Atomic Energy Commission, and members of the Commission itself, and the Chairman of the Commission, pointing out that special arrangements must be made for universities to use atomic materials, to have atomic laboratories, and indeed to have atomic reactors on their campuses.

Direct representations have been made to the Assistant Secretary of Defense concerning the position of the colleges in the Department of Defense's research program. It has been pointed out that the colleges are in a position to do good

research and to do it at a cost which is fair to both the Government and the college, and at the same time to reap educational benefits which depend on the college's virile research programs. Protests were made both by letter and personally against trade associations and combinations of manufacturers who would oust the colleges from the Department of Defense's research program, and I am pleased to report that this matter appears, at least for the time being, to be resolved in our favor.

In closing, I would like to thank all the members of the Council and all the others who have been so willing to work for the good of the engineering colleges when called upon by the officers or the Chairman. Lastly, I would like to thank all those who have been so helpful during the past two years and who have made my period of office a very pleasant one.

ERIC A. WALKER,
Chairman, Engineering College Research Council

ASEE Reprints Available

The following reprints can be obtained from the ASEE, Northwestern University, Evanston, Illinois. Except where otherwise indicated, the price is 20¢ each or 12¢ each in lots of 100 or more. Please enclose check made out to ASEE.

Interim Report of the Committee on Evaluation of Engineering Education

Report of Committee on Engineering Education After the War

Code of Ethics of Interviewing Procedures

Improvement of Engineering Teaching

Industry's Interest in More Education for Engineers—Grinter

Cooperative Education at the Graduate Level

Present Status and Trends of Engineering Education in the United States

Developing Cooperative Engineering Between Engineering Colleges and Secondary Schools

Manual of Graduate Study in Engineering (50¢)

Annual Report of the Engineering College Administrative Council

July 1, 1953–July 1, 1954

Executive Committee Meetings

Two Executive Committee Meetings were held during this year. On October 14, 1953, during the Fall ASEE–ECAC Meeting, the Executive Committee met to consider reports from standing committees, discuss matters of current importance, and plan a program for the 1954 annual meeting.

Activities for the Year 1953–54

A. *Committee Activity for Year*

The *International Relations Committee* has been studying one of the significant problems in this field, the provision of a period of industrial experience for foreign nationals who are pursuing graduate study here. Dean Dawson is chairman of a subcommittee to study this problem and plans to develop a program for the Annual Meeting.

ECAC has actively joined with EJC to assist in furthering the objectives of a Western Hemisphere engineering organization, the Union Panamericana de Asociaciones de Ingenieros (UPADI). Dean Steinberg is coordinating the ECAC efforts to aid EJC in its relations with UPADI.

Although no formal meetings of the *Foreign Operations Administration (FOA) Cooperation Committee* were held, a considerable amount of aid was rendered to the FOA by locating staff members for service abroad and in assisting U. S. universities to make contact with universities outside this country.

During the year FOA was aided by the committee in discussions of contracts between:

University of Chulalongkorn in India with the University of Texas
A university in Korea with the University of Minnesota
A university in Indonesia with the University of California
A university in Turkey with the University of Nebraska and/or New York University
A university in East Pakistan with Texas A. & M. College
A university in West Pakistan with Colorado A. & M. College
University of the Punyab area of Pakistan with Washington State College
University of Yugoslavia with the University of Kentucky
University of Israel with University of the State of New York
A university in British Guiana with the University of Maryland
A university in Lima, Peru, with North Carolina State College

In addition to these FOA activities, contacts were maintained with the U. S. Office of Education and with the Committee on International Exchange of Persons Conference Board of the Associated Research Councils.

The Committee on *Selection and Guidance* has had two projects for the year, research on an engineering graduate placement test and a list of books and pamphlets to be provided to deans of en-

gineering. Preparation of the lists is moving forward. This committee is cooperating with the Educational Testing Service in the Placement Test research.

In April, 1954, representatives of Bell Telephone System, Detroit Edison, B. F. Goodrich, International Business Machine Corporation, and Westinghouse met with the Educational Testing Service to lay plans for a cooperative research program aimed at development of placement tests for graduates in engineering. It is hoped that tests developed through this research may supplement the judgment and experience of the interviewers and result in improved manpower utilization.

The *Manpower Committee* has had few critical issues which needed definite action. A resolution endorsing the work of the Engineering Manpower Commission was circulated to the membership of ECAC as Appendix II of the February, 1954, Executive Committee Bulletin.

Mr. Bridgman has been chairman of a subcommittee of the Manpower Commission of EJC to study the ROTC Branch General vs the Branch Material Programs. This study will be reported at the Annual Meeting of ASEE in Urbana. In addition, this committee has cooperated actively with the Survey Committee of EJC in its study of the current demand for engineering graduates. The Manpower Committee has cognizance over military affairs which affect the utilization of engineering graduates while the Military Affairs Committee considers the effect of military affairs on the educational programs of engineering colleges.

The *Military Affairs Committee* has made two major studies during the year. Last fall a study was made of the action of the Air Force in changing the regulations governing the award of commissions to students completing the advanced AF–ROTC program. From the standpoint of engineering education, no cause was found for protest by ASEE.

Later, a study was undertaken of the Army's interest in the Branch General ROTC Program. After due consideration it was reported that, as then administered, the Branch General Program offered no threat to engineering education and should not be protested. In order to check the opinion of the committee, all deans having ROTC units were canvassed. Those answering the question were over 3 to 1 opposed to a protest from ASEE against the Army's desire to change from Branch Material to Branch General.

The *Committee on Secondary Schools* is continuing its study of High School-College articulation in the fields of mathematics, physics, and chemistry.

B. *News Bulletins*

ECAC Executive Committee Bulletins were circulated twice during the year to our membership and to the ASEE officers and council members.

C. *Programs*

The Engineering College Administrative Council has presented programs at two national meetings during the year.

On October 15 at New York City, ECAC and ECRC presented a day's program on the theme "Creativeness in Engineering." Dean Everitt presided at the afternoon session which presented the point of view of the industrialist.

W. L. EVERITT, *Chairman*
W. T. ALEXANDER, *Secretary*

Report of the Treasurer

Ernest C. Davies
Certified Public Accountant
Evanston, Illinois

July 27, 1954

Mr. G. W. Farnham
American Society for Engineering Education
Evanston, Illinois

Dear Mr. Farnham:

In accordance with your instructions we have examined the accounts and records of the American Society for Engineering Education for the year ending June 30, 1954 and submit herewith the following statements prepared therefrom:

Exhibit I—Comparative Balance Sheets
Exhibit II—Comparative Statements of Changes in Funds and Special Accounts
Exhibit III—Comparative Statements of Income and Expense
Exhibit IV—Comparative Statements of Receipts and Disbursements

In connection with the statements as of June 30, 1954 we examined and tested the accounting records, traced the receipts as recorded to deposit, checked the disbursements, counted the securities on hand, and secured direct confirmation for all funds or securities in the hands of outside parties. Accounts receivable and payable were accepted as recorded without confirmation. With this exception our examination was made in accordance with generally accepted auditing standards and included all procedures which we considered necessary in the circumstances.

Based upon the above considerations, in our opinion, these statements and accompanying footnotes fairly present the position of the Society at June 30, 1954 and the results of operations for the year then ended.

Sincerely,

ERNEST C. DAVIES
Certified Public Accountant

AMERICAN SOCIETY FOR ENGINEERING EDUCATION
COMPARATIVE BALANCE SHEETS
EXHIBIT I

	June 30, 1953	June 30, 1954
Assets		
Current Fund:		
Cash—Checking Accounts (Exhibit IV)	$27,826.54	$ 39,539.38
—Savings Accounts		15,000.00
Petty Cash	300.00	300.00
U. S. Government Bonds—Series G	30,700.00	31,700.00
Accounts Receivable		
Advertising	3,588.01	2,494.47
Dues	1,800.00	1,800.00
Westinghouse Educ. Foundation	474.01	444.81
Due from Lamme Fund	279.58	355.94
Prepaid Travel Expense	425.00	425.00
Prepaid Postage and Supplies		530.00
Inventory	1.00	1.00
Furniture and Fixtures	1.00	1.00
Total Current Fund **	$65,395.14	$ 92,591.60
Life Membership Fund *		
Cash	212.06	
U. S. Government Bonds—Series G	1,000.00	
Due from General Fund	25.00	
Total Life Membership Fund	$ 1,237.06	
B. J. Lamme Fund		
Cash	290.25	290.25
Income Cash in Hands of Trustee	237.25	240.02
Principal Cash in Hands of Trustee	3.86	5.51
Securities and Mortgages	10,137.87	10,136.22
Total Lamme Fund	$10,669.23	$ 10,672.00
Total Assets **	$77,301.43	$103,263.60

* Life membership transferred to current fund of Society by ruling of Executive Board.

** The increase in current fund and total assets is due largely to funds received from outside organizations which are reserved for special projects. These funds are not available for general Society operation.

Liabilities and Capital	June 30, 1953	June 30, 1954
Current Fund:		
Due to Life Membership	25.00	
Other Accruals	4,234.56	1,006.00
	$ 4,259.56	$ 1,006.00
Dues Collected in Advance	$ 864.21	$ 771.25
Excess of Contributions over Disbursements (Exhibit II)		
Teaching Aids	6,228.11	6,767.51
Evaluation of Engineering Education	187.30	5,012.45
Humanistic-Social Research		20,457.15
	$ 6,415.41	$ 32,237.11
Surplus		
Reserve for Special Projects	5,317.19	5,317.19
Reserve for ECRC	4,253.16	6,430.19
Unappropriated Surplus (Exhibit II)	44,285.61	46,829.86
	$53,855.96	$ 58,577.24
Total Current Fund	$65,395.14	$ 92,591.60
Life Membership Surplus *	$ 1,237.06	
B. J. Lamme Fund:		
Due to General Fund	279.58	355.94
Surplus	10,389.65	10,316.06
Total Lamme Fund (Exhibit II)	$10,669.23	$ 10,672.00
Total Liabilities and Capital	$77,301.43	$103,263.60

* Life membership transferred to current fund of Society by ruling of Executive Board.

STATEMENT OF CHANGES IN FUNDS AND SPECIAL ACCOUNTS
EXHIBIT II

Current Fund Surplus	12 Months Ended June 30, 1953	12 Months Ended June 30, 1954
Balance at Beginning of Period	$46,107.19	$44,285.61
Add: Excess of Income over Expense		3,483.16
Transfer to ECRC Reserve		(2,177.03)
Transfer of Life Membership to General Fund		1,238.12
	$46,107.19	$46.829.86
Less: Excess of Expense over Income (Exhibit III)	3,491.18	
Transfer from ECRC (Exhibit III)	(1,803.46)	
Transfer of Income Cash to Lamme Fund	133.86	
Balance at End of Period (Exhibit I)	$44,285.61	$46,829.86

	12 Months Ended June 30, 1953	12 Months Ended June 30, 1954
B. J. Lamme Fund		
Balance at Beginning of Period	$ 5,304.81	$10,389.65
Add: Transfer of Income Cash from General Fund	133.86	
Contributions Received	5,000.00	
Earnings of the Fund	230.56	227.77
	$10,669.23	$10,617.42
Less: Award and Expense	279.58	301.36
Balance at End of Period (Exhibit I)	$10,389.65	$10,316.06
Receivable—Westinghouse Foundation		
Balance at Beginning of Period	$ 323.69	474.01
Add: Expense	150.32	220.80
	474.01	694.81
Less: Reimbursement Received		250.00
Balance at End of Period (Exhibit I)	474.01	444.81
Teaching Aids		
Balance at Beginning of Period	$ 6,975.12	$ 6,228.11
Add: Receipts	50.00	1,125.00
	$ 7,025.12	$ 7,353.11
Less: Disbursements	797.01	585.60
Balance at End of Period (Exhibit I)	$ 6,228.11	$ 6,767.51
Evaluation of Engineering Education		
Balance at beginning of period		$ 187.30
Add: Receipts	6,000.00	13,000.00
	$ 6,000.00	$13,187.30
Less: Disbursements	5,812.70	8,174.85
Balance at end of period (Exhibit I)	$ 187.30	$ 5,012.45
Humanistic-Social Project		
Receipts		$30,000.00
Expenses		9,542.85
Balance at end of period (Exhibit I)		$20,457.15

COMPARATIVE INCOME AND EXPENSE STATEMENTS
EXHIBIT III

	12 Months Ended June 30, 1953	12 Months Ended June 30, 1954	Budget 1953–1954
Income:			
Current Dues—Individual	$40,394.45	$43,128.72	$40,600.00
—Institutional	9,185.00	12,877.60	10,000.00
Sale of Publications	2,887.00	3,271.71	2,800.00
Advertising	13,390.97	17,502.89	18,500.00
Interest on Bonds	792.50	792.50	780.00
ECRC	247.08	2,177.03	
Refund Unused Registration Fee Annual Meeting	689.24	527.27	
Miscellaneous	269.95	64.27	
Total Income	$67,856.19	$80,341.99	$72,680.00
Expense:			
Cost of Publications	26,062.46	29,832.45	30,000.00
Secretary's Salary	7,500.00	7,500.00	7,500.00
Assistant Secretary's Salary	3,240.00	3,240.00	3,240.00
Clerical Salaries	8,833.06	10,534.79	10,860.00
Retirement Emeritus	1,360.00	1,360.00	1,360.00
Travel—Secretary, Asst. Secretary, Office Secretary	1,906.51	2,649.91	2,450.00
Postage, Telephone and Telegraph	2,364.13	1,840.55	2,400.00
Supplies and Sundry Printing	4,342.65	5,415.65	4,500.00
Dues—American Council on Education	200.00	400.00	200.00
Dues—EJC	204.00	652.28	550.00
Contribution—ECPD	500.00	700.00	500.00
Contribution—Life Membership Fund	25.00		25.00
Officers' Travel	1,886.57	2,348.32	2,500.00
Meeting Expense	3,069.30	2,604.37	2,500.00
Expenses—ECAC	1,301.37	915.85	2,200.00
Expenses—ECRC	6,400.54	2,525.38	4,350.00
Committees and Conferences	926.16	1,699.02	1,300.00
Bonding, Auditors and Other Fees	359.84	340.68	
Refunds		198.47	
Special Projects and Miscellaneous			1,000.00
Young Engineering Teachers Award	300.00	300.00	
Graduate Manual	367.80		
Cooperative Eng. Educ. Report	95.48		
Contribution to ECPD for Eval. of Eng. Educ.	100.00	100.00	
Purchase of Adding Machine *		292.25	
Purchase of Addressing Machine *		387.01	
Purchase of Typewriter *		830.30	
Purchase of Desk and Chair *		170.63	
Miscellaneous	2.50	20.92	
	$71,347.37	$76,858.83	$77,435.00
Excess of Income over Expense (Expense over Income)	(3,491.18)	3,483.16	(4,755.00)
Transfer to (from) ECRC Reserve	(1,803.46)	2,177.03**	
Balance to Surplus (Exhibit II)	(1,687.72)	1,306.79	

* Equipment purchased has been charged as operating expense rather than being capitalized. This is in accordance with previous practice as established by the Executive Board.

** Sale of ECRC publications.

COMPARATIVE STATEMENT OF RECEIPTS AND DISBURSEMENTS
EXHIBIT IV

	12 Months Ended June 30, 1953	12 Months Ended June 30, 1954
Cash—Beginning of Period	$29,627.76	$ 27,826.54
Receipts		
Dues—Current	47,044.20	52,755.10
—Back Dues	2,027.00	2,387.01
—In Advance	864.21	771.25
Sale of Publications	2,887.00	3,271.71
Advertising	12,550.40	18,596.43
Interest on Bonds	792.50	792.50
ECRC		2,177.03
Westinghouse Educ. Foundation	247.08	250.00
Lamme Fund		225.00
Life Membership Fund		238.12
Teaching Aids	50.00	1,125.00
Evaluation of Engineering Education	6,000.00	13,000.00
Humanistic-Social Project		30,000.00
Unused Registration Fee—Annual Meeting	689.24	527.27
Miscellaneous	345.48	64.27
Total Receipts	$73,497.11	$126,180.69
Disbursements		
Cost of Publication	26,112.46	30,196.45
Administrative and Clerical Salaries (1)	19,573.06	21,274.79
Retirement Emeritus	1,360.00	1,360.00
Travel—Secretary's Office	1,955.79	2,469.91
Postage, Telephone and Telegraph	2,376.38	1,854.55
Supplies and Sundry Printing	4,236.45	6,051.85
Dues—American Council on Education	200.00	400.00
Dues—EJC	204.00	652.28
Contribution—ECPD	500.00	700.00
Contribution—Life Membership Fund		25.00
Officers' Travel	1,844.93	2,389.96
Meeting Expense	3,251.16	1,911.39
Expenses—ECAC	1,301.37	815.85
Expenses—ECRC	2,778.84	6,147.08
Committees and Conferences	926.16	1,699.02
Bonding, Auditors and Other Society Fees	334.84	514.68
Refunds		198.47
Special Projects and Miscellaneous (2)	1,553.28	2,101.11
Westinghouse Award	75.32	85.80
Expense—B. J. Lamme Fund	204.58	216.36
—Teaching Aids Fund	797.01	585.60
—Evaluation of Engineering Education	5,712.70	8,274.85
—Humanistic-Social Research		9,542.85
Transfer to Savings Accounts		15,000.00
	$75,298.33	$114,467.85
Cash—End of Period (Exhibit I)	$27,826.54	$ 39,539.38

	12 Months Ended June 30, 1953	12 Months Ended June 30, 1954
(1) Administrative and Clerical Salaries		
Secretary's Salary	7,500.00	7,500.00
Assistant Secretary's Salary	3,240.00	3,240.00
Clerical	8,833.06	10,534.79
Total	$19,573.06	$ 21,274.79
(2) Special Projects and Miscellaneous		
Young Engineering Teachers Award	300.00	300.00
Graduate Manual	367.80	
Coop. Engineering Education Report	95.48	
Special Travel of President	687.50	
Contribution to ECPD for Evaluation of Eng. Education	100.00	100.00
Purchase of Adding Machine		292.25
Purchase of Addressing Machine		387.01
Purchase of Typewriter		830.30
Purchase of Desk and Chair		170.63
Miscellaneous	2.50	20.92
Total	$ 1,553.28	$ 2,101.11

INCOME AND EXPENSE, 1953–54
BUDGET, 1954–55

	12 Months Ended June 30, 1954	Budget 1954–1955
Income:		
Current Dues—Individual	$43,128.72	$ 49,100.00
—Institutional	12,877.60	12,000.00
Sale of Publications	3,271.71	2,800.00
Advertising	17,502.89	20,000.00
Interest on Bonds	792.50	780.00
ECRC	2,177.03	
Refund Unused Registration Fee, Annual Meeting	527.27	
Miscellaneous	64.27	
Total Income	$80,341.99	$ 84,680.00
Expense:		
Annual Meeting	2,604.37	3,000.00
Journal and Proceedings	29,832.45	30,000.00
Committees and Conferences	1,699.02	2,000.00
Postage, Telephone and Telegraph	1,840.55	2,500.00
Supplies, Expense, Sundry Printing	5,415.65	4,500.00
Travel Expense—Secretary's Office	2,649.91	2,000.00
Officers Travel Expense	2,348.32	3,000.00
ECAC	915.85	2,200.00
ECRC	2,525.38	4,350.00
Administrative Salaries	21,274.79	23,500.00
Retirement Emeritus Assistant Secretary	1,360.00	1,360.00
Bonding Fees and Auditors	340.68	375.00
Dues (American Council on Education)	400.00	200.00
ECPD (Contribution)	700.00	500.00
Contingencies and Sp. Projects	2,101.11	2,000.00
EJC Dues	652.28	700.00
Refunds	198.47	
Total Expense	$76,858.83	$ 82,185.00
Excess of Income over Expense	$ 3,483.16	$ 2,485.00
Transfer to ECRC Reserve	$ 2,177.03	
Balance to Surplus	$ 1,306.13	

Minutes of the Executive Board

A meeting of the Executive Board of the American Society for Engineering Education was held at the Urbana-Lincoln Hotel on June 13, 1954. Those present included L. E. Grinter, *President*, W. L. Everitt, B. R. Teare, Jr., E. A. Walker, W. C. White, *Vice Presidents*, G. W. Farnham, *Treasurer*, A. B. Bronwell, *Secretary*, C. E. Watson, *Assistant Secretary*, Thorndike Saville, guest; M. Strohm, office secretary.

Report of the Secretary

1. The Secretary reported that the Amendment to By-law IV had been voted upon favorably by 76% of the voting membership. The total number of ballots cast was 2,283.

2. The Secretary also reported on the new method of handling dues notices. Members under 36 years of age as of July 1 would be entitled to a lower dues status, but would be required to give their date of birth.

Report of the Treasurer

The Treasurer presented the tentative annual audit, which indicated an estimated excess of income over expense of $1,307 (final audit). The ECRC handled its principal publication costs in last year's budget, and for this reason its expenses were abnormally low this year. On the income side, individual and Institutional dues exceeded budget by $4,300, in part due to the success of the Associate Institutional Membership drive. Most items of expense were in line with budget except for ECRC and ECAC expenses, which were held down to effectuate economies.

Reports of Vice Presidents

Written reports of the four Vice Presidents on activities within their jurisdictions were presented.

Amendments to EJC Constitution

Dean Thorndike Saville, President of EJC, reported on the proposed changes in the EJC Constitution. The amendments provide for three new classifications of membership as follows:

a. *Associate Membership*, consisting of national engineering societies which meet the requirements for membership in EJC except that they do not have the number of members required for full membership;

b. *Affiliate Members*, consisting of engineering societies which are regional rather than national in scope, but which have the qualifications for voting members equivalent to those required of constituent societies.

c. *Individual Members*, consisting of engineers who hold voting membership in any one of the constituent societies of EJC, or who hold an engineering degree from a college of recognized standing, or who have equivalent attainments, including at least six years of engineering experience of satisfactory character.

The discussion revolved around the desirability of instituting individual membership. The principal values of individual membership are: (1) to bring the members of the engineering profession into closer proximity to the operations of EJC, and (2) to provide additional income to finance EJC. The objections are:

> It is unlikely that EJC would get a very substantial number of individual members. If EJC has only a few thousand individual member, this would greatly weaken its position in making recommendations to Congress and the federal government on national problems bearing upon engineering, since it would be extremely difficult to sustain the idea that EJC represents the entire engineering profession if it has only a few thousand individual members. The problems handled by EJC are problems of national scope, requiring experienced judgment on the part of the best qualified engineers of the country. These are not problems which can be referred to an individual membership for "vote."

The Executive Board suggested that EJC could establish meaningful grass roots con-

nections with the individual members of the engineering profession by preparing publicity releases to be published monthly in each of the engineering societies' journals. These would describe the current progress on principal EJC activities. They would invite individual members of the engineering profession to offer suggestions and recommendations on EJC projects and thus establish a constructive grass roots contact with the entire engineering profession, rather than with a few thousand individual members.

The Executive Board recommended to the General Council that it approve all of the proposed Constitutional Amendments except Article 5, dealing with individual members, and to table this amendment until the Fall Meeting of the Executive Board and General Council.

Division and Committee Budgets

The Executive Board voted to allow an annual budget of $35 for each division and committee, without special request. If a division or committee wishes an amount in excess of $35, it should present a specific request to the Board.

UPADI and EUSEC Representatives

It was reported that the ASEE representative to UPADI will be Dean W. A. Lewis of Illinois Institute of Technology. This is a meeting of Pan American countries dealing with engineering and engineering education. The alternate delegate will be Dr. Ralph Morgen of National Science Foundation.

The ASEE representative to EUSEC (European conference on Engineering Education in Switzerland) will be President L. E. Grinter. He will also Represent the ECPD.

Evaluation of Engineering Education

Publication of the Interim Report of the Committee on Evaluation of Engineering Education will be followed up by requests to the Institutional Committees that they prepare reports giving their viewpoints on this report and its implementation. These will be reproduced by each institution in quantity sufficient to supply all of the engineering colleges of the country. These institutional reports will be collected and distributed by Professor Pletta. In view of this responsibility and additional activities, the board voted to continue Professor Pletta's services on a part time basis.

The Board voted to sell reprints of the Interim Report for 20¢ each in quantities less than 100 and 12¢ each for 100 or more.

ASEE Publication Board

The suggestion was made that the Secretary prepare a proposal for the formation of a Publication Board to make recommendations on all publications of ASEE.

Teaching Aids Bulletin

The question was raised as to the current status of the Teaching Aids Bulletin. The Secretary stated that this is now in the hands of the printer and that an Editorial Review Committee had been appointed to follow through on this publication. The Bulletin will be out in the Fall of 1954.

Summer Schools

The Executive Board considered ways of assisting Divisions and Committees of the Society in their financing of Summer Schools. The Board expressed the opinion that Summer Schools should be planned on a self-financing basis, which is usually possible by virtue of the fact that Summer Schools are permitted to charge a registration fee of $1.50 per day per person. However, in order to help divisions which might incur a deficit, the Board voted to recommend to the General Council that a revolving Summer School fund be set up. Deficits on Summer School operations would be paid out of this revolving fund and any excess of income over expense would be placed in the fund. The Board also requested that each application for Summer School be accompanied by an outline of the proposed program and a budget.

Summer Institutes

The Executive Board discussed the policy with respect to approval of Summer Institutes. The Board recommended that ASEE maintain authority in approving both a Summer Institute program and its budget, before it is submitted to any outside agency for financial assistance. However, after the project has been approved, the Division or the host institution sponsoring the Summer Institute would be free to seek financing and handle its own planning provided that such efforts are consistent with those presented in the proposal and are handled in a manner which will safeguard the dignity and interests of the Society.

Honorary Memberships

Although the ASEE Constitution has provision for Honorary Membership, there has never been a statement of qualifications for such membership. Because of disagreements on the qualifications for Honorary Membership, this matter was turned over to the Committee on Honorary Memberships with the request that they prepare a recommendation to present to the General Council. The Executive Board recommended that not more than two or three Honorary Memberships be granted in any one year in order to establish high prestige for this distinction.

Resolution of the Southwest Section

Two resolutions of the Southwest Section were presented. The first resolution dealt with the endorsement of a particular candidate for nomination. This resolution was referred to the Nominating Committee.

The Second resolution is as follows:

"*Whereas,* The American Society for Engineering Education is primarily and essentially an organization of engineering *teachers,* and

"*Whereas,* for some time past, the representation in the national offices has been drawn almost entirely from among the college administrators, now, therefore, *Be It Resolved,* that the Southwest Section submit to the General Council a request for a study of the feasibility of creating an additional vice-presidency which will provide representation from the college classroom teachers in the A.S.E.E. on the Executive Board of the Society by specifying that this office shall be held only by a college classroom teacher who is not an administrator."

The Executive Board requested that this resolution be referred to the Nominating Committee and to the Committee on Constitution and By-Laws.

Manual for the Annual Meeting

The Executive Board voted to approve preparation of a manual on the Annual Meeting. It was suggested that this manual be kept in loose leaf form so that it can be readily revised.

Associate Institutional Membership

The application of the Association of American Railroads for institutional membership was considered. A letter to one of the principal railroad companies indicated that their affiliation with a society such as ASEE could take place only through the medium of the Association of American Railroads. The Executive Board voted to approve the application of the Association of American Railroads but expressed the opinion that the Society should continue to seek membership among the individual companies.

Advertisements for Teaching Positions

The Board assessed the possibility of including in the JOURNAL advertisements for individuals seeking teaching positions. This was tabled for a future meeting of the Board.

Resolution of the ECRC Executive Committee

A resolution of the ECRC Executive Committee stating that they feel that no divisional meetings should be scheduled at the same time as the ECRC general session program was presented. The Executive Board felt that in general attempts should be made to minimize the conflicts of divisions and general sessions and requested that the Program Committee consider this problem in planning the program for next year.

* * *

A meeting of the Executive Board of the American Society for Engineering Education was held on June 16, 1954 in the Colonial Room of the Illini Union. Those present included L. E. Grinter, *President,* W. L. Everitt, B. R. Teare, E. A. Walker, W. C. White, *Vice Presidents,* A. B. Bronwell, *Secretary,* C. E. Watson, *Assistant Secretary,* G. W. Farnham, *Treasurer,* N. W. Dougherty, L. J. Lassalle, H. K. Work, (new officers), N. A. Christensen (guest), and M. Strohm, *Office Secretary.*

Future Annual Meetings

The Executive Board voted to accept the invitation of Cornell University to hold the 1957 Annual Meeting on its campus during the week of June 17–21.

The 1955 Annual Meeting will be held at Pennsylvania State University and the 1956 Annual Meeting at Iowa State College.

Printing Costs

The Treasurer submitted to the Board the report of the Committee on Printing Costs. This showed that the cost of printing the monthly issues of the JOURNAL would be approximately the same using the offset process as using type. However, it might

be possible to effect a saving in the cost of printing the yearbook. The Treasurer stated that he is contacting several printing firms in the South to see whether lower printing rates might be possible.

It was pointed out that a saving can be effected by arranging the pages in multiples of sixteen or thirty-two, rather than a smaller multiple.

Graduate Study Project

The proposal of the Graduate Studies Division for a survey project, to be financed by contributions from industry, was considered by the Executive Board. There was a divergence of viewpoint as to the objectives to be sought in such a study. Professor Christiansen stated that the principal purpose of the project will be to determine objectives and goals of graduate study and that although the accumulation of factual data would be necessary, this would not constitute the principal object of the study. The Board members expressed the opinion that the program should be formulated more specifically and that there should be a sharper definition of objectives before the Society should attempt to seek finances. The Board voted to recommend to the Council that a committee be appointed to formulate a specific proposal for the project. This committee would consist of officers of the Graduate Studies Division and members of the ASEE Committee on Evaluation of Engineering Education in order to establish adequate liaison with the Evaluation Committee. This action was in conformity with a similar resolution passed at the luncheon of the Graduate Studies Division. The Board further recommended that traveling expenses be provided, out of the Evaluation funds, for the Committee meeting.

Report of Committee on Society Finances

The report of the Committee on Society Finances was presented. The Board voted to adopt the recommendations of the Committee and implement these as expeditiously as possible. This resolution recommends certain investments of Society funds and also recommends, as a safety feature, that the Society seek to build up its unappropriated reserve to three-fourths of the annual operating expense.

Bank Resolutions

The Executive Board voted to authorize the new officers of the Society to sign bank resolutions, checks, and savings withdrawals.

Request of Engineering Economy Committee for Division Status

A petition of the Engineering Economy Committee for division status was discussed. The Board requested that this petition be transmitted to the Committee on Society functions with a request that this committee prepare a statement of policy relating to the formation of new Divisions and the possible discontinuance of existing Divisions which have unsatisfactory attendance. The Board further requested the Committee on Society Functions to consider the petition of the Committee on Engineering Economy as a part of this study.

ECRC Activities

Vice President Walker pointed out that members of ECRC have a natural interest in meetings of the Industrial Research Council, the National Research Council and the Conference on Management of Research. Because of these interests, there is difficulty in getting adequate interest in research activities at the Annual Meeting of the Society. This was made more acute this year by scheduled conflicts with the ECRC General Session program. He pointed out that ECRC has been requested to cooperate with other research agencies in the formation of joint meetings. The Executive Board offered two suggestions, first that ECRC cooperate with other research organizations in sponsoring joint meetings and second that ECRC invite some of these organizations to hold joint meetings in conjunction with the ASEE Annual Meeting. This would assure a sufficiently large attendance to justify outstanding programs.

Additional Matters

The following additional matters discussed at the Board meeting are reported in the Minutes of the General Council Meeting:

a. The Humanistic-Social Research Project.
b. Honorary Memberships in ASEE.
c. Report of Committee on Degree Designation.
d. Progress report on Summer Institute program.

Respectfully submitted,

ARTHUR BRONWELL,
Secretary

Minutes of the General Council Meeting

A meeting of the General Council of the American Society for Engineering Education was held in the Colonial Room, Illini Union, on June 14, 1954. Those present included: L. E. Grinter, *President;* B. R. Teare, Jr., W. C. White, W. L. Everitt, E. A. Walker, *Vice Presidents;* G. W. Farnham, *Treasurer;* A. B. Bronwell, *Secretary;* C. E. Watson, *Assistant Secretary;* J. M. Apple, H. H. Armsby, H. R. Beatty, G. P. Brewington, C. A. Brown, W. L. Collins, F. M. Dawson, M. A. Durland, E. H. Gaylord, W. P. Godfrey, H. E. Hartig, K. L. Holderman, H. K. Justice, F. Kerekes, H. Kuenzel, G. D. Lobingier, G. A. Marston, G. Murphy, E. F. Obert, R. S. Paffenbarger, G. K. Palsgrove, N. A. Parker, N. F. Rode, H. P. Rodes, Thorndike Saville, R. H. Schoonover, J. W. Shirley, E. B. Stavely, L. E. Stout, N. D. Thomas, R. W. Van Houten, R. E. Vivian, J. S. Walton, K. F. Wendt, E. R. Wilcox, C. L. Wilson, W. R. Woolrich; M. Strohm, *Office Secretary.*

Report of the Secretary

1. The Secretary reported that the Executive Board had voted to discontinue the Life Membership Fund and to transfer the funds to the general fund of the Society.

2. He also reported that the Amendment to By-Law IV had been voted favorably by 76% of the 2,283 ballots cast.

Report of the Treasurer

The Treasurer reported on the tentative annual audit. This report is included in the minutes of the Executive Board meeting of June 13, 1954.

The budget for 1954–55 (Appendix A) was presented and discussed. The council voted to approve the tentative annual audit and budget.

Evaluation of Engineering Education

President Grinter reviewed the development of the project Evaluation of Engineering Education. A preliminary report, prepared by the Committee on Evaluation of Engineering Education, drawing upon the recommendations of 88 Institutional Committees, was circulated to the Institutional Committees and Deans of engineering colleges for comment. Two proposals in the preliminary report which dealt with accreditation, namely those of bifurcation of curricula and special designation for exceptionally meritorious accreditation of curricula were almost unanimously rejected by the Institutional Committees, hence they were omitted in the later report. A meeting of representatives from industry stressed the importance of strengthening the underlying scientific background throughout the engineering program. A meeting of the full committee was held in Atlanta, Georgia, to consider some of the problems of the report. This was followed later by a two-day meeting of a small writing committee which had the responsibility of preparing the Interim Report. This Interim Report was approved by substantially all of the committee before its publication and was presented formally to the Society membership at the General Session at the Annual Meeting.

It was thought that the Interim Report should be reviewed within one year and that a final report should be prepared, based upon the recommendations of Institutional Committees. Also, the suggestion was made that each Institutional Committee be invited to prepare its recommendations relative to the Interim Report. It was suggested that these be prepared in sufficient quantity that one copy of each report be made available to the library of each engineering college in the country. These could be sent to the secretary of the Committee on Evaluation of Engineering Education for binding, together with a copy of the report.

Canon of Ethics

The General Council considered ways and means of getting the ECPD Canon of Ethics more widely accepted and used in engineering colleges. It was recommended that the Deans of engineering colleges be asked to present a copy of the Canon of Ethics to each graduating senior. The Executive

Board also voted to send suitable copies to all officers, Council members, and Deans of engineering colleges. It was pointed out that the Canon of Ethics should be presented to graduating seniors in a climate which will impress upon them its significance in their future professional outlook and work.

Humanistic-Social Research Project

The progress in setting up the Humanistic-Social Research Project, under a grant of $30,000 from Carnegie Corporation, was reviewed by Vice President White. Dr. Edwin S. Burdell, President of Cooper Union, has accepted chairmanship of the Committee on the Humanistic-Social Research Project. Dr. George Gullette, head of the Department of Social Studies at North Carolina State College, is serving as Director of the project on a part time basis. A field committee has been appointed to investigate programs in those engineering colleges in the country where considerable thought has been given to the development of suitable curricular offerings.

Summer Institutes

The progress of setting up Summer Institutes in Solid State Physics in Engineering Education and Nuclear Science in Engineering Education was reviewed. The two Summer Institutes this year are supported by grants from the National Science Foundation totaling $15,500. Each Summer Institute has been preceded by a closed conference of 20 to 30 leading authorities in the field to formulate the objectives and help to get the material clarified and organized.

Summer Institutes in Thermodynamics and Advanced Mathematics as applied to various fields of engineering, the teaching of mechanics in physics and engineering courses, and the teaching of electricity and magnetism in physics and engineering are being currently considered for 1955.

Summer Schools

The difficulties in working out the details in registration and attendance at Summer Schools this year were mentioned. This was particularly acute inasmuch as the Society sponsored six Summer Schools, whereas no more than two have been sponsored in any previous year. It was recommended that a committee be appointed to study the relationships between Summer Schools and the Annual Meeting of the Society and present recommendations for improvement. This committee would also collaborate with the committee which is preparing a manual on the Annual Meeting of the Society.

It was pointed out that divisions desiring to sponsor Summer Schools should present their proposals and budgets prior to the October 27th meeting of the General Council.

A recommendation of the Executive Board that a revolving fund be set up to underwrite the expenses of Summer Schools and that the excess of income over expense of Summer Schools be placed in this fund was defeated.

A request of the Chemical Engineering Division for a Summer School in 1955 was presented. It was suggested that the Division submit a program and budget for the consideration of the Executive Board.

A motion to send an expression of appreciation to all those responsible for organizing Summer Schools and Summer Institutes was unanimously voted.

* * *

A meeting of the General Council of the American Society for Engineering Education was held on Friday, June 18, 1954, in the Colonial Room of the Illini Union. Those present included L. E. Grinter, *President;* B. R. Teare, Jr., W. C. White, W. L. Everitt, E. A. Walker, *Vice Presidents,* A. B. Bronwell, *Secretary,* George Farnham, *Treasurer,* and Marion Strohm, *Office Secretary;* E. E. Ambrosius, H. H. Armsby, H. R. Beatty, G. P. Brewington, C. A. Brown, N. A. Christensen, A. P. Colburn, W. L. Collins, F. M. Dawson, A. Diefendorf, W. W. Domberger, N. W. Dougherty, M. A. Durland, A. J. Fairbanks, C. D. Fawcett, O. C. French, E. H. Gaylord, F. F. Groseclose, W. Hazell, K. L. Holderman, G. Hollistor, H. K. Justice, F. Kerekes, H. Kuenzel, L. J. Lassalle, E. J. Lindahl, G. D. Lobingier, G. A. Marston, J. C. McKeon, A. J. McNair, G. Murphy, R. S. Paffenbarger, G. K. Palegrove, N. A. Parker, H. P. Rodes, Thorndike Saville, R. Schoonover, L. Z. Seltzer, J. W. Shirley, P. E. Soreson, E. B. Stavely, L. E. Stout, N. D. Thomas, R. E. Vivian, J. S. Walton, E. R. Wilcox, and H. K. Work.

EJC Amendments

The recommendations of the Executive Board meeting of June 13, relating to the proposed amendments of the Engineers'

Joint Council Constitution were discussed. The General Council voted to endorse the recommendations of the Executive Board, which is to approve all amendments except Amendment 5, relating to individual members, this amendment being tabled without prejudice for discussion at the Fall Meeting of the Council.

Proposal of the Graduate Studies' Division

The recommendation of the Executive Board meeting of June 16, 1954, to appoint a committee consisting of members of the Graduate Studies Division and of the Committee on Evaluation of Engineering Education to formulate a specific proposal for the Graduate Studies' Project was discussed and approved. Such a proposal would make it possible to solicit funds and proceed as rapidly as possible in getting the project under way.

Resolution to Dr. Grinter

Vice President White presented a resolution of appreciation to Dr. Grinter for his outstanding leadership during the past year. This resolution was unanimously adopted by the General Council.

Resolution of the Technical Institute Division

A resolution of the Technical Institute Division presented to the Council in June, 1952, was discussed. This resolution requested Society endorsement of the title "Engineering Technician" for graduates of technical institutes and also the use of an appropriate Associate degree to designate completion of work.

A committee was appointed in 1952 to study the resolution. This committee in its report in June, 1953, accepted the resolution with reservations on the use of the word "engineering." The General Council did not feel that this action was definitive enough for a vote by the Council and requested that another committee be formed to consider not only the matter of degree designations for graduates of technical institutes, but also the entire matter of degree designations, including the desirability of differentiating between the four- and five-year engineering degrees. The committee carried out correspondence during the year and held a meeting at the Annual Meeting of the Society. Dean H. K. Justice presented the report of the committee, which consisted of a vote 3 to 2 in favor of recommending adoption of the Technical Institute Division Resolution. Dean Justice stated that the Technical Institute representatives on the committee favored adoption of the resolution, whereas the engineering school representatives were opposed to it.

President Grinter stated that ECPD has accepted use of the word "engineering" as an adjective in describing technical institute curricula and graduates, but not as a noun and suggested that this might provide a way out of the dilemma. President H. R. Beatty pointed out that the ECPD had prepared specific definitions for "professional engineer" and "engineering technician" and stated that the resolution of the Technical Institute Division was in conformity with these definitions. President Rodes stated that the Technical Institute Division has tried to use terms which were clear and fair and in conformity with the practice in Junior Colleges. He stated that over 400 Junior Colleges grant the "associate degree" in other fields. He pointed out that several Technical Institutes associated with engineering colleges now grant associate degrees in engineering.

There was some question as to the desirability of leaving the title "associate degree" open-ended without specifying whether the word engineering is to be used in this title. President Rodes stated that the practice differs in various states, and therefore that it was not possible to make a specific recommendation. It was also pointed out that this problem has important implications insofar as the public is concerned, since it is necessary to adopt terminology which will not mislead prospective students. In order to help them to make correct decisions, it is necessary to delineate between the Technical Institute type of education and the engineering type of education, without prejudice to either.

Dean Saville moved that this matter be studied for another year and that the committee be expanded to include a number of different points of view. The council adopted this resolution.

Activities of Engineers' Joint Council

Dean Saville reviewed the activities of EJC, including the attempts of EJC to get engineers appointed to top positions on the Board of Engineers of the St. Lawrence Seaway Project, the activities of the Water

Policy Committee, the coming meetings of UPADI, EUSEC, and the World Power Conference, the Hoover Commission, and many others. He emphasized the active part which ASEE is taking in EJC activities.

Resolution of Technical Institute Division

The following resolution of the Technical Institute Division was presented.

"*Be It Resolved*

"That the Technical Institute Division request the approval and support of the ASEE to organize and develop with the aid of foundation funds a project devoted to the study of that part of engineering education concerned with the education and training of engineering technicians and other technical personnel who assist the professional engineer in carrying on his work.

"*Be It Further Resolved*

"That such a study and its prosecution be subject to cancellation as an independent project should the Society itself undertake a study that would encompass all phases of engineering education, including those areas served by the technical institute."

This resolution furthers the general purpose of the Society, which is to make thorough studies of education at all levels in engineering and technical institute curricula. The Council voted to adopt its resolution.

Applications for Membership in ASEE

The Council voted to approve the latest list of 130 applicants for membership in ASEE.

Delinquencies

The Executive Board voted to drop from membership 201 members owing two or more years' dues.

Life Memberships

The Executive Board voted to grant life memberships to 14 members of the Society who meet all the constitutional requirements for life membership.

Application of Engineering Economy Committee for Division Status

The Secretary read a petition (Appendix E) from the Committee on Engineering Economy requesting Division status. The Council voted to refer this problem to the Committee on Society Functions with the request that they also study the more general problem of the formation and dissolution of Divisions.

Report of the Committee on Society Functions

Vice President Teare presented a brief progress report of the Committee on Society Functions. It is expected that this committee will complete its assignment and prepare a final report during the current year. The committee is studying, among other problems, the methods of nominating officers to see if: (1) it would be feasible to require that one member of the Executive Board be selected from outside the Dean or Administrator ranks; (2) it would be possible to get more complete biographical information on proposed candidates; and (3) it would be desirable to hold the election of officers in the fall so that the incoming officers would have an opportunity to become acquainted with current Society problems and develop a program for the following year before the time of the Annual Meeting.

Associate Institutional Membership

Mr. Jesse McKeon presented a report of his Committee on Associate Institutional Membership, stating that the Society now has 111 Associate Institutional Members, whereas two years ago it had three Associate Members. He expressed the view that this could be further expanded.

Other Matters

The following are additional items taken up at the council meeting which are reported in the Minutes of the Executive Board Meeting.

a. Report of the Secretary.
b. Report of the Treasurer.
c. EJC Amendments.
d. Honorary Membership.
e. Future Annual Meetings
f. Printing costs.

Respectfully submitted,

ARTHUR BRONWELL,
Secretary

Report of the Resolutions Committee

ASEE Annual Banquet—June 17, 1954

Mr. Chairman, Ladies and Gentlemen:

For the Committee on Resolutions, comprising Colonel J. H. Belknap of the Radiation Laboratory, University of California, Dean G. F. Brannigan of the University of Arkansas, Mr. D. S. Bridgman of the American Telephone and Telegraph Company, Dean W. R. Woolrich of the University of Texas, and myself, I take pleasure in offering the following resolution:

To the University of Illinois and all members of her gracious family who planned so thoughtfully the happy arrangements for this 62nd Annual Meeting and who have been such generous and delightful hosts throughout our stay on this spacious campus, we of the American Society for Engineering Education express our wholehearted thanks. We gratefully acknowledge the excellent provisions made for our comfort, convenience, and entertainment, the high competence with which our whole program of conferences was facilitated and made both pleasant and profitable.

We wish in particular to voice our appreciation to the Officers of the University —President Morey and Dean Everitt, to Professor Lisle Rose, General Chairman of the Local Committee and to all members of his organization, including the ladies who ministered so hospitably to our families. As we return to our home communities we shall carry with us the fruitful experiences of this memorable week together with fond memories of old friendships renewed and of new friendships formed while we have been guests on this campus.

With one accord we salute the University of Illinois and our colleagues on her staff who have been such perfect hosts throughout this Annual Meeting.

Mr. President, I move the adoption of this Resolution.

Adopted unanimously.

W. C. WHITE, *Chairman*

Resolution Presented by Vice President W. C. White

Mr. Chairman:

This meeting of old and new members of the Council seems a particularly happy and appropriate occasion to voice our hearty thanks to our President, Dr. Grinter, for his devoted and highly competent leadership of the Society during the past year. He has carried not only the substantial burdens of the Presidency, but also the Chairmanship of the important Committee on Evaluation of Engineering Education whose activities have been tremendously time consuming throughout the year. Those of us here who have been privileged to work closely with him are mindful of the exhausting responsibilities involved in this dual task. We gratefully acknowledge his patience, perseverance, scholarly forward look, and the fine personal qualities that make it such a pleasure to work with him. We are deeply appreciative of the magnificent leadership which he has given to us in 1953–54.

Resolution unanimously adopted.

News of Engineers' Joint Council Activities

Engineers' Joint Council Organizes Group to Meet Nuclear Problems. 1955 Convocation Planned

To meet "the pressing problems of nuclear engineering and the related sciences," with particular interest in "industrial usefulness," Engineers' Joint Council, composed of major American engineering societies with a total membership of 170,000, today announced initial steps toward an organized program of confronting these problems "authoritatively by a group of leading engineers."

In making the announcement, Thorndike Saville, President of the Council and Dean of Engineering at New York University, commented that "action by this powerful engineering group is further evidence that nuclear energy is well on the way to having important peace time industrial usefulness."

An invitation will be extended to the societies of physicists and chemists to join the engineers in planning a strong organization, it was reported by Warren L. McCabe, Administrative Dean at Brooklyn Polytechnic Institute, Chairman of Engineers' Joint Council Committee on Recognition of Specialties in Engineering. The movement is expected to bring together most of the country's eminent participants in industrial nuclear development.

Although organization of the new group is in its initial stages, a national convocation in the Summer or Fall of 1955 is contemplated for nuclear development for industrial use. The pressing problems of nuclear engineering and the related sciences are to be dealt with authoritatively by a group of leading engineers.

In this announcement, Thorndike Saville, President of Engineers' Joint Council, is joined by Daniel V. Terrell, President of the American Society of Civil Engineers; Leo F. Reinartz, President of the American Society of Mining and Metallurgical Engineers; Lewis K. Sillcox, President of The American Society of Mechanical Engineers; Alexander C. Monteith, President of the American Institute of Electrical Engineers; Chalmer G. Kirkbride, President of the American Institute of Chemical Engineers; Dale L. Maffitt, President of the American Water Works Association; William E. Blewett, Jr., President of the Society of Naval Architects and Marine Engineers, and Nathan W. Dougherty, President of the American Society for Engineering Education. Under the general policy of Engineers' Joint Council to encourage the close cooperation of specialists in engineering, a strong joint agency will be set up to organize the cooperation of all engineering groups and related scientists to develop discussions of nuclear engineering subjects and to deal with the publication of worthwhile papers and addresses.

Engineers' Joint Council Amends Constitution to Broaden Participation

In a major action to increase the unity of the engineering profession, Engineers' Joint Council has adopted two important constitutional amendments permitting, under prescribed conditions, the admission of national and local organizations not presently meeting all the qualification for constituent membership. Conditions for admission are being drafted by a special committee.

Engineers' Joint Council at present is constituted of eight major engineering organizations with a total individual membership of 170,000. These are the American Society of Civil Engineers,

American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Water Works Association, American Institute of Electrical Engineers, Society of Naval Architects and Marine Engineers, American Society for Engineering Education and American Institute of Chemical Engineers.

The amendments were made effective by the Executive Committee on July 8, following affirmative action by each of the constituent societies. A total membership of at least 5,000 is required of a national organization to qualify as a constituent society. The first amendment permits the admission as Associates of national organizations with less than 5,000 members.

The second amendment permits the admission, as Affiliates, of societies "which are regional rather than national in geographical scope." This amendment also permits the admission as Affiliates of "federations of engineering societies (or of sections of such societies) broadly representative of the engineering profession in cases in which the majority of the societies who are members of the federation have qualifications for voting members equivalent to those required of constituent societies of the Council.

In both instances, Associates and Affiliates, the one relating to national organizations and the other to local or regional organizations, admission will be without official vote. Nonetheless, provision is made for representatives to participate in the Council's meetings.

To achieve these objectives, the Council acts as an advisory and coordinating agency to seek and study matters of mutual interest to the constituent societies and to recommend parallel action by them; represents the constituent societies in instances in which these societies desire such joint representation; administers, on behalf of the engineering profession, activities authorized by a majority of the constituent societies.

The officers of Engineers' Joint Council are: President, Thorndike Saville; Vice President, Carlton S. Proctor; Treasurer, E. Lawrence Chandler; Secretary, Stewart E. Reimel.

Do You Know—

(*Continued from page 100*)

► Again we come to a parting of the roads where we regretfully lose some of our active officers but acquire a new Executive Board to fill their mission. Our high esteem and deep appreciation go to Past President L. E. Grinter, Vice President W. C. White and Vice President Eric A. Walker who have cooperated so wholeheartedly and who helped to pilot ASEE activities to new heights of achievement during the past year. We eagerly welcome the new association with President Dougherty, Dean Lassalle and Dr. Work who have already taken a vigorous role in planning forthcoming ASEE activities.

► Mark it down now—the next Annual Meeting at Pennsylvania State University, June 20–24, 1955.

With best regards,
ARTHUR BRONWELL, *Secretary*

Officers of Divisions, Committees and Sections

1954-55

DIVISIONS

AERONAUTICAL: L. Z. Seltzer, Chairman, West Virginia University

AGRICULTURAL: R. H. Driftmier, Chairman, University of Georgia

ARCHITECTURAL: J. E. Branch, Chairman, University of Miami

CHEMICAL: R. W. Moulton, Chairman, University of Washington

CIVIL ENGINEERING: J. W. Hubler, Chairman, Washington University

COOPERATIVE ENGINEERING EDUCATION: J. G. Wohlford, Chairman, Georgia Institute of Technology

EDUCATIONAL METHODS: E. B. Stavely, Chairman, Pennsylvania State University

ELECTRICAL: J. N. Thurston, Chairman, Clemson Agricultural College

ENGINEERING DRAWING: T. T. Aakhus, Chairman, University of Nebraska

ENGLISH: T. Farrell, Jr., Chairman, University of Iowa

EVENING ENGINEERING EDUCATION: C. Schaffner, Chairman, Brooklyn Polytechnic Institute

GRADUATE STUDIES: N. A. Christensen, Chairman, Cornell University

HUMANISTIC-SOCIAL: G. A. Gullette, Chairman, North Carolina State College

INDUSTRIAL ENGINEERING: B. H. Norem, Chairman, Syracuse University

MATHEMATICS: C. O. Oakley, Chairman, Haverford College

MECHANICAL ENGINEERING: I. W. Smith, Chairman, University of Toronto

MECHANICS: F. L. Singer, Chairman, New York University

MINERAL ENGINEERING: J. C. Calhoun, Jr., Chairman, Pennsylvania State University

PHYSICS: R. J. Seeger, Chairman, National Science Foundation

RELATIONS WITH INDUSTRY: J. F. D. Smith, Chairman, Iowa State College

TECHNICAL INSTITUTE: C. S. Jones, Chairman, Academy of Aeronautics

COMMITTEES

ANNUAL MEETING: L. J. Lassalle, Chairman, Louisiana State University

ASSOCIATE INSTITUTIONAL MEMBERSHIP: Dwayne Orton, Chairman, IBM Corporation, New York, N. Y.

ATOMIC ENERGY EDUCATION: P. N. Powers, Chairman, Monsanto Chemical Company, St. Louis, Missouri

CONSTITUTION AND BY-LAWS: H. O. Croft, Chairman, University of Missouri

DEGREE DESIGNATION IN COLLEGES OF ENGINEERING AND TECHNICAL INSTITUTES: J. H. Sams, Chairman, Clemson Agricultural College

DIVISIONS AND CURRICULAR COMMITTEES: L. J. Lassalle, Chairman, Louisiana State University.

ENGINEERING ECONOMY: A. J. Lesser, Jr., Chairman, Stevens Institute of Technology

ENGINEERING SCHOOL LIBRARIES: J. H. Moriarty, Chairman, Purdue University

ETHICS: C. J. Freund, Chairman, University of Detroit

EVALUATION OF ENGINEERING EDUCATION: L. E. Grinter, Chairman, University of Florida

FINANCIAL POLICY: W. R. Woolrich, Chairman, University of Texas

GEORGE WESTINGHOUSE AWARD: F. Pumphrey, Chairman, University of Florida

GRADUATE STUDY PROJECT (Ad Hoc): E. Weber, Chairman, Polytechnic Institute of Brooklyn

HONORARY MEMBERSHIP: J. H. Davis, Chairman, Stevens Institute of Technology

HUMANISTIC-SOCIAL RESEARCH PROJECT: Edwin S. Burdell, Chairman, The Cooper Union, New York, N. Y.

JAMES H. MCGRAW AWARD: M. R. Graney, Chairman, Purdue University

JUDGES FOR YET PAPER CONTEST: J. W. Hubler, Chairman, Washington University

LAMME AWARD: F. E. Terman, Chairman, Stanford University

MEMBERSHIP: P. Weinberg, Chairman, University of Utah

NOMINATING: S. C. Hollister, Chairman, Cornell University

PRINTING ECONOMY (Ad Hoc): G. W. Farnham, Chairman, The Ronald Press Company, New York, N. Y.

PUBLICATIONS: A. B. Bronwell, Chairman, Northwestern University

PUBLIC RELATIONS: L. A. Rose, Chairman, University of Illinois

RECOGNITION AND INCENTIVES FOR GOOD TEACHING: R. W. Schmelzer, Chairman, Rennselaer Polytechnic Institute

SECTIONS AND BRANCHES: B. R. Teare, Jr., Chairman, Carnegie Institute of Technology

SOCIETY FUNCTIONS: B. R. Teare, Jr., Chairman, Carnegie Institute of Technology

TEACHING AIDS BULLETIN (Editing Committee): F. D. Carvin, Chairman, Illinois Institute of Technology

TEXTILE ENGINEERING: R. Carson, Chairman, Clemson College

YOUNG ENGINEERING TEACHERS: P. Weinberg, Chairman, University of Utah

SECTIONS

ALLEGHENY: W. D. Garman, Chairman, Bucknell University

ILLINOIS-INDIANA: G. E. Ellithorn, Chairman, University of Notre Dame

KANSAS-NEBRASKA: G. W. Bradshaw, President, University of Kansas

MICHIGAN: C. C. Sigerfoos, Chairman, Michigan State College

MIDDLE ATLANTIC: H. N. Jenkins, Chairman, Swarthmore College

MISSOURI-ARKANSAS: M. M. Jones: Chairman, University of Missouri

NATIONAL CAPITAL: J. C. Michalowicz, Chairman, Catholic University of America

NEW ENGLAND: E. R. McKee, Chairman, University of Vermont

NORTH MIDWEST: C. J. Pratt, Chairman, Michigan College of Mining and Technology

OHIO: K. F. Sibila, Chairman, University of Akron

PACIFIC NORTHWEST: M. L. Jackson, Chairman, University of Idaho

PACIFIC SOUTHWEST: B. M. Green, Chairman, Stanford University

ROCKY MOUNTAIN: D. F. Peterson, Chairman, Colorado A. & M. College

SOUTHEAST: H. V. Flinsch, President, Mississippi State College

SOUTHWEST: V. L. Doughtie, Chairman, University of Texas

UPPER NEW YORK: N. A. Christensen, Chairman, Cornell University

Officers of the Society and Members of the General Council are listed on Page 2 of this issue.

Section Meetings

Section	*Location of Meeting*	*Dates*	*Chairman of Section*
Allegheny	Bucknell University	April, 1955	W. D. Garman, Bucknell University
Illinois-Indiana	University of Notre Dame	May 21, 1955	G. E. Ellithorn, University of Notre Dame
Kansas-Nebraska	University of Nebraska	Oct. 22–23, 1955	G. W. Bradshaw, University of Kansas
Michigan	Michigan State College	May 17, 1955	C. C. Sigerfoos, Michigan State College
Middle Atlantic	Brooklyn Polytechnic Institute	Dec. 4, 1954	H. N. Jenkins, Swarthmore College
Missouri-Arkansas	University of Missouri	April 2, 1955	M. M. Jones, University of Missouri
National Capital Area	Catholic University	Oct. 5, 1954	J. C. Michalowicz, Catholic University
New England	Massachusetts Institute of Technology	Oct. 9, 1954	E. R. McKee, University of Vermont
North Midwest	Michigan College of M. and T.	Oct. 8–9, 1954	C. J. Pratt, Michigan College of M. and T.
Ohio	A.F. Inst. Wright	Sept. 17–18, 1954	K. F. Sibila, University of Akron
	University of Akron	May 7, 1955	
*Pacific Northwest	Oregon State College	Spring, 1955	M. L. Jackson, University of Idaho
Pacific Southwest	California Institute of Technology	Dec. 28–29, 1954	B. M. Green, Stanford University
*Rocky Mountain	University of Utah	Fall, 1954	D. F. Peterson, Colorado A. and M. College
Southeast	University of Tennessee	April 14–16, 1955	H. V. Flinsch, Mississippi State College
Southwest	University of Oklahoma	April 8–9 1955	V. L. Doughtie, University of Texas
Upper New York	Cornell University	Oct. 22–23, 1954	N. A. Christensen, Cornell University

Members of the Society are welcome at all Section Meetings

* No Date Set.

New Members

AFZALI, SHUJAAT A. K., Head Shop Instructor, Karachi Polytechnic Institute, Karachi, Pakistan. E. R. Stapley, H. P. Adams.

AGNEW, JOHN T., Professor of Mechanical Engineering, Purdue University, Lafayette, Ind. O. W. Witzell, J. B. Jones.

AHMED, N., Head Shop Instructor, Karachi Polytechnic Institute, Karachi, Pakistan. E. R. Stapley, H. P. Adams.

ALDINGER, L. A., Director, Education and Training, Research Laboratories Division, General Motors Corporation, Detroit, Mich. J. C. McElhany, W. E. Snyder.

ALI, MOHAMMAD S., Head Shop Instructor —Machine Shop, Karachi Polytechnic Institute, Karachi, Pakistan. E. R. Stapley, H. P. Adams.

AMERMAN, PRESTON I., Director of Employment, Detroit Edison Co., Detroit, Mich. A. R. Hellworth, C. J. Freund.

AREAUX, VIRGIL G., Assistant Professor of Mechanical Engineering, Tri-State College, Angola, Ind. A. A. Hockey, S. S. Radford.

BARTUNEK, PAUL F., Associate Professor of Physics, Colorado School of Mines, Golden, Colorado. G. W. LeMaire, F. K. Sabott.

BONNER, THOMAS W., Chairman and Professor of Physics, Rice Institute, Houston, Tex. R. J. Seeger, R. A. Morgen.

CASHION, JAMES J., Instructor Engineering, New York State Maritime College, Bronx, N. Y. J. J. Connor, Jr., J. J. Foody.

CESSNA, S. ROGER, Administrative Engineer —Technical Recruiting and Training, Major Appliances Division, General Electric Co., Buechel, Kentucky, K. B. McEachron, Jr., M. M. Boring.

CHAPMAN, HARMON M., Director of General Studies, New York University, New York, N. Y. T. Saville, H. Torgersen.

CHOLET, BERTRAM, Vice President, Higgins Ink Co., Brooklyn, New York. A. Jorgensen, C. P. Buck.

COCHRAN, STANLEY W., Manager Admission, Standards and Services, RCA, Camden, New Jersey. J. S. Morehouse, J. J. Goller.

COYNE, MARTIN A., Personnel Manager, The M. W. Kellogg Co., New York, N. Y. J. D. Constance, J. Cundelan.

CURTIS, CARROLL A., Assistant Professor of Civil Engineering, University of Idaho, Moscow, Idaho. N. F. Hindle, M. L. Jackson.

DANNER, CHARLES S., Assistant Professor of Civil Engineering, University of Illinois, Urbana, Ill. M. O. Schmidt, J. C. Huntington.

DAY, ROBERT W., Assistant Professor of Mechanical Engineering, University of Massachusetts, Amherst, Mass. G. K. Palsgrove, J. W. Bursik.

DOVE, RICHARD C., Assistant Professor T. and A. M., Iowa State College, Ames, Iowa. G. Murphy, A. R. Livingston.

EBAUGH, PAUL, Assistant Director, Engineering Research, Pennsylvania State University, State College, Pa. E. A. Walker, E. B. Stavely.

EBERT, IAN O., Associate Professor of Electrical Engineering, Michigan State College, East Lansing, Mich. R. W. Ludt, R. L. Sweet.

EKBERG, CARL E., JR., Assistant Professor of Civil Engineering, Lehigh University, Bethlehem, Pa. J. O. Liebig, Jr., C. D. Jensen.

EVERILL, RICHARD T., Employment Manager, Carrier Corporation, Syracuse, New York. J. H. Carpenter, W. E. Renner.

FOX, EDWARD A., Assistant Professor of Mechanics, Rensselaer Polytechnic Institute, Troy, New York. C. E. Work, R. H. Trathen.

GARROTT, WILLIAM L., Associate Professor of Electrical Engineering, University of Nevada, Reno, Nev. D. V. Terrell, A. L. Chamhas.

GREEN, THOMAS F., Instructor in English and Social Sciences, South Dakota School of Mines and Technology, Rapid City, So. Dak. R. D. LaRue, E. H. Stevens.

GYAW, B. AUNG, Workshop Superintendent, University of Rangoon, Rangoon, Burma. W. L. Collins, J. O. Smith.

HART, DUANE D., Assistant Professor of Mechanical Engineering, Clarkson College of Technology, Potsdam, New York. E. McHugh, M. G. Mochel.

HART, WALTER T., JR., Captain U. S. Navy, Inspector of Naval Material, Detroit, Mich. C. J. Freund, A. B. Bronwell.

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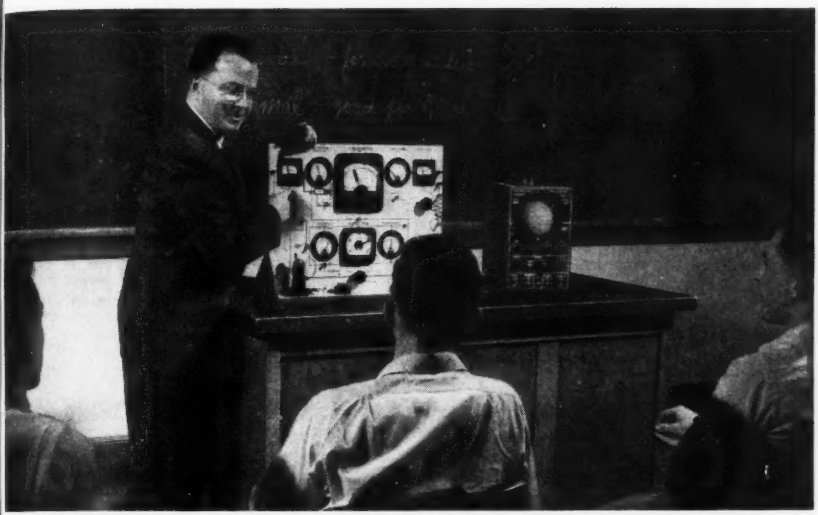

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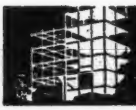

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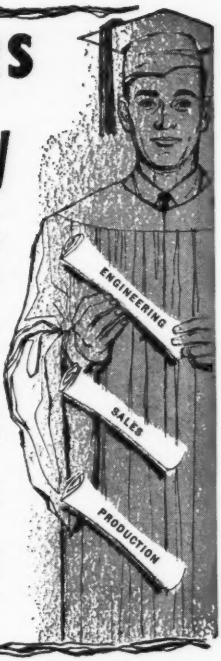

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